September 23, 2022 FedEx: 770019780857

Mr. Dave Cline
IDEM
Office of Air Quality
100 N. Senate Avenue
Indianapolis, IN 46204

RE: REPORT TRANSMITTAL – EQM PN: 050812.0025
TC Energy- ANR Pipeline
Lagrange Compressor Station-TR01
2255 West U.S. 20
LaGrange, IN
IDEM Permit No. 087-42922-00004

Mr. Cline,

On behalf of our client, TC Energy, ANR Pipeline Company, I would like to submit the attached report with the results of the recent emissions testing performed on the Turbine TR01 located in LaGrange, IN.

The test was performed on August 18, 2022, as specified in the testing requirements described in the current operating permit no. 087-42922-00004. Testing procedures were applied as required to meet the testing requirements in the above-mentioned permit under Title 40, Code of Federal Regulations, Part 3, Subpart YYYY (40 CFR 63 (YYYY) for the Turbine TR01.

TC Energy respectfully requests the timely review and approval of this submittal. If you have any questions or concerns regarding this matter, please contact me at your convenience at (219) 661-9900 or kmast@eqm.com.

Respectfully submitted,
EQM, Inc.

Karl Mastalski
Manager, Emission Measurement

Attachments: Compliance Test Report –TC Energy – LaGrange Compressor Station –Turbine TR01(1 Copy)

I have reviewed the information being submitted and, based on information and belief formed after reasonable inquiry; I certify that the statements and information contained in this submittal for LaGrange CS-Unit TR01, EQM PN: 050812.0025, are true, accurate and complete.

Signature of Responsible Official: _____

Date: 9-21-2022

Printed Name of DAR:
Dustin Enright
Director US Pipelines Operations – Heartland Region
Responsible Official for Emissions & Testing Document Submittals

Electronic copy: Pedro Amieva – Environmental Advisor

DELIVERED

Tuesday

9/27/2022 at 9:54 am

Signed for by: T.LCKETT

Obtain Proof of delivery

DELIVERY STATUS

Delivered

Get Status Updates

LAGRANGE TR01 QY REPORT 050812.0025

770019780857

FROM
Environmental Quality Mngmt
Anova Frasure
1280 Arrowhead Ct., Suite 2
Crown Point, IN US 46307
2196619900

Label Created
9/23/2022 11:07 AM

PACKAGE RECEIVED BY FEDEX
MICHIGAN CITY, IN
9/26/2022 4:51 PM

IN TRANSIT
INDIANAPOLIS, IN
9/27/2022 8:46 AM

OUT FOR DELIVERY
INDIANAPOLIS, IN
9/27/2022 8:46 AM

DELIVERED
David Cline
IDEM Office of Air Management
100 N SENATE AVE IGCN1003
INDIANAPOLIS, IN US 46207
3172328443

DELIVERED
9/27/2022 at 9:54 AM

↓ View travel history

Manage Delivery

Shipment facts

Travel history

COMPLIANCE TEST REPORT
ANR PIPELINE-LAGRANGE COMPRESSOR STATION
TURBINE UNIT TR01

August 18, 2022

Prepared for:

TC Energy

TC Energy's ANR Pipeline Company
LaGrange, IN
Permit 087-42922-00004

Prepared by:

Environmental Quality Management, Inc.
1280 Arrowhead Court
Suite 2
Crown Point, IN 46307
(219) 661-9900
www.eqm.com

PN: 050812.0025

September 2022

PREFACE

I, Karl Mast, do hereby certify that the source emissions testing conducted at TC Energy in LaGrange, Indiana was performed in accordance with the procedures set forth by the United States Environmental Protection Agency, and that the data and results submitted within this report are an exact representation of the testing.

Karl Mast
Test Supervisor

I, Karl Mast, do hereby attest that all work on this project was performed under my direct supervision, and that this report accurately and authentically presents the source emissions testing conducted at ANR Pipeline's LaGrange Compressor Station in LaGrange, IN.

Karl Mast
Test Supervisor

SUMMARY

The compliance testing was performed on the Turbine Unit TR01 in accordance with the requirements of Permit 087-42922-00004, in order to comply with Title 40, Part 63, Subpart YYYY. The results of the testing are detailed in the following tables.

Turbine Unit TR01- CH2O ppbvd @ 15% O2 Summary Results					
Run 1	Run 2	Run 3	Average	Permit Limit	Pass/Fail
91	74	70	78	≤91	Pass

CONTENTS

TABLES

FIGURES

APPENDICES

1. INTRODUCTION

This report presents the results of the source emissions testing conducted by Environmental Quality Management, Inc. (EQM) for TC Energy's ANR Pipeline (ANR) at LaGrange compressor station, near LaGrange, IN, which is in LaGrange County.

The primary purpose of this testing program was to conduct emissions testing to determine compliance with Permit 087-42922-00004 for the Turbine Unit TR01 that is subject to 40 CFR Part 63, Subpart YYYY requirement at ANR Pipeline's gas compressor facility. The test plan listed that the turbine is a Mars 90 Turbine. The permit lists the Turbine is a Mars 100.

EQM's responsibility was to conduct the compliance testing for the O2 and CH2O emissions rates, record process operating data per compliance test requirements, and perform data reduction for conformance evaluation. EQM contracted the services of Prism Analytical Technologies to assist in the testing event. ANR Pipeline's responsibility was to maintain process operating parameters and to assist in providing process operating data per compliance test requirements.

The following report provides information pertaining to TC Energy's process operations, and Compliance testing. The Compliance testing conducted on the Mars 100Turbine TR01 was performed on August 18, 2022 from 9:40 A.M. to 1:35 P.M.

The following requirements were specific for the testing program:

1. Equipment calibrations were performed and calibration data provided.
2. Three (3) sixty (60) -minute, minimum, O_2 and H2CO test runs performed at Turbine Unit TR01 at maximum achievable load and speed according to pipeline conditions pursuant to EPA, Title 40, Code of Federal Regulations, Part 60, Appendix A.
3. FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer configured with a StarBoost system. The StarBoost technology consists of a 5-micron infrared detector, optical filtration and signal amplification. It is designed to optimize signal response and limit instrument noise for low detection limit applications. The FTIR was equipped with a temperature-controlled, 5.11-meter multipass gas cell maintained at 191°C. All data were collected in differential mode with 2 cm-1 resolution sample data and 8 cm-1 resolution background. Each FTIR spectrum was derived from the coaddition of 220 scans, with a new data point generated approximately every 60 seconds.

4. Process manufacturing operations maintained at 100 +/- 10 percent peak load condition, or at maximum achievable load according with ambient conditions, and fuel consumption rates recorded during the emissions testing periods.

5. All testing and analyses performed in accordance with current EPA test methodologies and analytical procedures for O_2 and CH2O emissions determinations.

6. Stratification was found to be less than 5% in the turbine exhausts.

7. Diluent corrected stratification test was performed in accordance with Subpart YYYY.

The testing program was approved by and/or coordinated with Pedro Amieva, TC Energy's ANR Pipeline Company. The emission testing was overseen by Karl Mast, Manager, Emission Measurement and Project Manager. The emission testing was conducted by James Carey, Prism analytical Technologies. The emission testing was not observed by regulatory personnel.

2. TEST RESULTS SUMMARY

The compliance testing was performed on the Turbine Unit TR01 in accordance with the requirements of the Title 40, Code of Federal Regulations, Part 63, Subpart YYYY (40 CFR 63, Subpart YYYY. A summary of the test results is given below:

Table 1. Turbine Unit TR01- CH2O ppbvd @ 15% O2 Summary Results					
Run 1	Run 2	Run 3	Average	Permit Limit	Pass/Fail
91	74	70	78	≤91	Pass

Based on the information provided above, the Turbine Unit TR01 met the acceptance criteria for CH2O ppbvd @ 15% O2 during the course of the testing. A complete list of performance parameters for each test run that was performed at the stack sampling locations can be found in Appendix A

Additional testing information may be found in Appendix B.

3. PROCESS DESCRIPTION

TC Energy's ANR LaGrange Compressor Station is located at 2255 West U.S. 20, in LaGrange, Indiana and operates a Mars 100 stationary gas turbine using a SoLoNOx (lean premixed) as control. It exhausts to Stack S03.

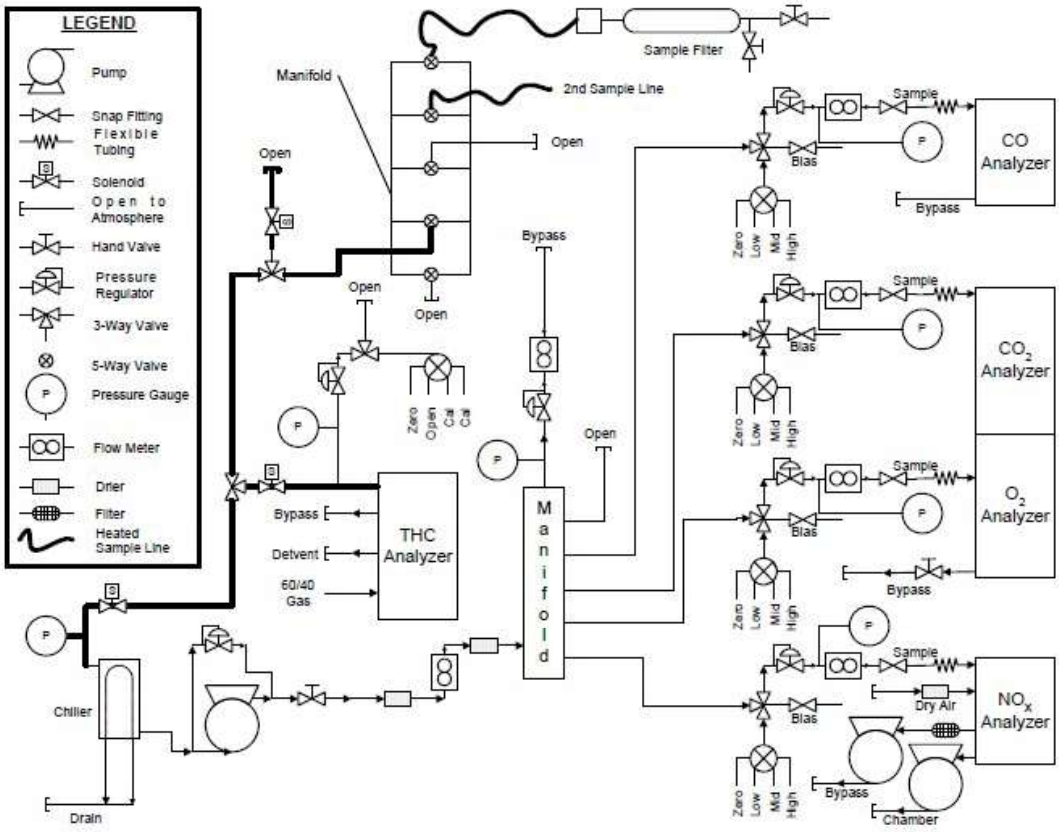
The Mars 100 gas turbine (TR01) is a simple cycle, natural gas fired, split-shaft turbine. In a simple cycle turbine, filtered atmosphere air is first compressed by the axial flow compressor. The hot compressed air is then fired with natural gas in the combustor. The hot exhaust gases expand through two turbine stages. The gas producer (G.P.) turbine drives the axial flow air while the power turbine (P.T.) drives the centrifugal pipeline compressor. The pipeline gas compressor moves natural gas through the pipeline by compressing it from an initial "suction" state to a more compressed "discharge" state.

The following table provide a summary of the production rates for the Turbine Unit TR01 during the test based on pipeline conditions: Additional process data and information may be found in Appendix B.

Table 2. Turbine Unit TR01- RPM

Run 1	Run 2	Run 3	Average	% Load
7934	7785	7717	7,812	97.9

Figure 1. Flow Schematic



Additional Information pertaining to the Fuel Flows may be found in Appendix B.

4. TEST PROCEDURES

EQM and EQM's affiliates and subcontractors use current U.S. EPA accepted testing methodologies in their Air Quality Programs as listed in the U.S. Code of Federal Regulations, Title 40, Part 60, Appendix A. For this testing program, the following specific methodologies were utilized:

- U.S. EPA Method 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)
- [1]U.S. EPA Method 320– Determination of Formaldehyde Concentrations in Emissions From Stationary Sources using StarBoost™ Technology (Instrumental Analyzer Procedure)

USEPA Methods 3A and 320 were performed by using USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy". Gaseous samples were withdrawn from the stack and transferred to the FTIR spectrometer.

FTIR data were collected using an MKS MultiGas 2030 FTIR spectrometer configured with a StarBoost system. The StarBoost technology consists of a 5-micron infrared detector, optical filtration and signal amplification. It is designed to optimize signal response and limit instrument noise for low detection limit applications. The FTIR was equipped with a temperature-controlled, 5.11-meter multipass gas cell maintained at 191°C. All data were collected in differential mode with 2 cm-1 resolution sample data and 8 cm-1 resolution background. Each FTIR spectrum was derived from the coaddition of 220 scans, with a new data point generated approximately every 60 seconds.

Sample gas continuously flew through the FTIR gas cell via heated head sampling pump. Total sample flow was approximately eight liters per minute. Gas flow and sampling system pressure were monitored using a rotameter and pressure transducer.

Formaldehyde spiking was performed at each source prior to testing to verify the ability of the sampling system to quantitatively deliver a sample containing formaldehyde from the base of the probe to the FTIR. The spike target dilution ratio was 1:10 or less. Analyte spiking assures the ability of the FTIR to quantify formaldehyde in the presence of effluent gas.

As part of the spiking procedure, samples from the source were measured before spiking to determine native concentrations to be used in the spike recovery

calculations. The analyte spiking gas contained nitrous oxide (N2O). The determined N2O concentration in the spiked sample was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked formaldehyde.

Additional information may be found in Appendix A.

Calculations that were used:

Calibration Correction

$$C_{GAS} = (C_R - C_O)\frac{C_{MA}}{C_M - C_O}$$

Where:

CGAS: Corrected flue gas concentration (ppmvd)
CR: Flue gas concentration (ppmvd)
CO: Average of initial and final zero checks (ppmvd)
CM: Average of initial and final span checks (ppmvd)
CMA: Actual concentration of span gas (ppmvd)

Outlet Analyzer Drift Correction

$$Cgas = (CAve - CO)(\frac{Cma}{Cm-Co})$$

Where:

CGAS: Average effluent gas concentration adjusted for bias
CAve: Average unadjusted gas concentration indicated by data recorder for the test run
CO: Average of initial and final zero checks (ppmvd)
CM: Actual concentration of the upscale calibration gas
CMA: Average of initial and final system calibration bian check responses for the upscale calibration gas

EPA F-Factor

$$F_d = \frac{\left[\left(3.64 \cdot H_{Wt\%} \cdot 100\right) + \left(1.53 \cdot C_{Wt\%} \cdot 100\right)\right]}{\frac{GCV}{\rho_{FuelGas}}} \cdot 10^6 + \frac{\left[\left(0.14 \cdot N_{2Wt\%} \cdot 100\right) - \left(0.46 \cdot O_{2Wt\%} \cdot 100\right)\right]}{\frac{GCV}{\rho_{FuelGas}}} \cdot 10^6$$

Where:

F_d: Fuel specific F-factor, dscf/MMBtu
$H_{Wt\%}$: Hydrogen weight percent
$C_{Wt\%}$: Carbon weight percent
$N_{2Wt\%}$: Nitrogen weight percent
$O_{2Wt\%}$: Oxygen weight percent
GCV: Heating value of the fuel, BTU/dscf
$\rho_{Fuel\ Gas}$: Density of the fuel gas, lb/scf

N_2O Concentration/Dilution Factor

$$DF = \frac{N2O(spk)}{N2O(Direct)}$$

CS = DF * Spike(dir) + Unspike (1-DF) (Sec. 9.3.1 (2) USEPA Method 320)

Where:

DF = Dilution factor of the spike gas
N2O(dir) = N2O concentration measured directly in undiluted spike gas
N2O(spk) = Diluted N2O concentration measured in a spiked sample
Spikedir = Concentration of the analyte in the spike standard measure by the FTIR directly
CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

Figure 2. USEPA Method 320 Sampling Train

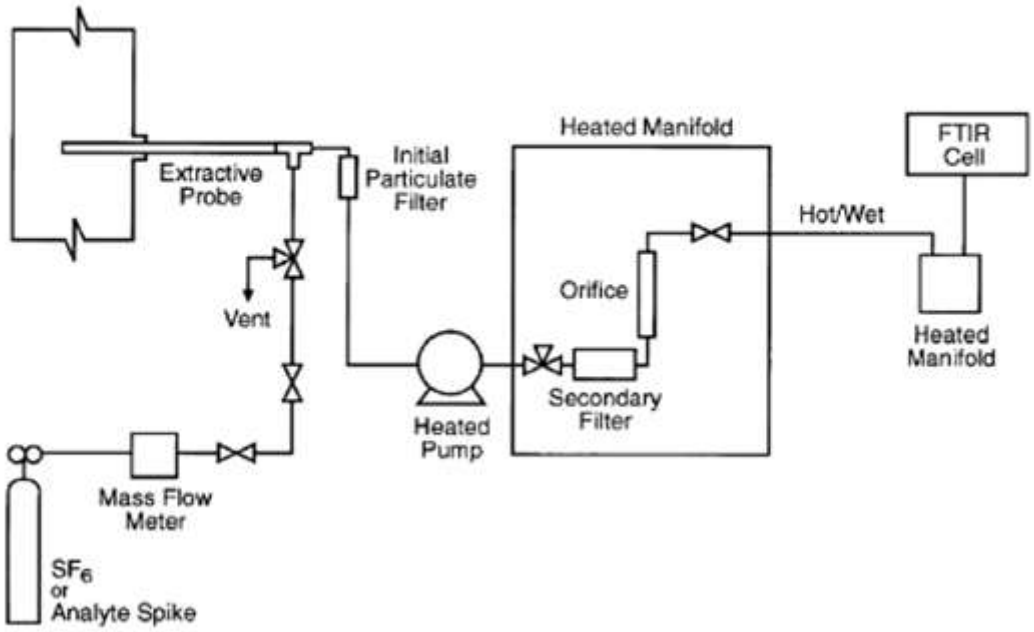
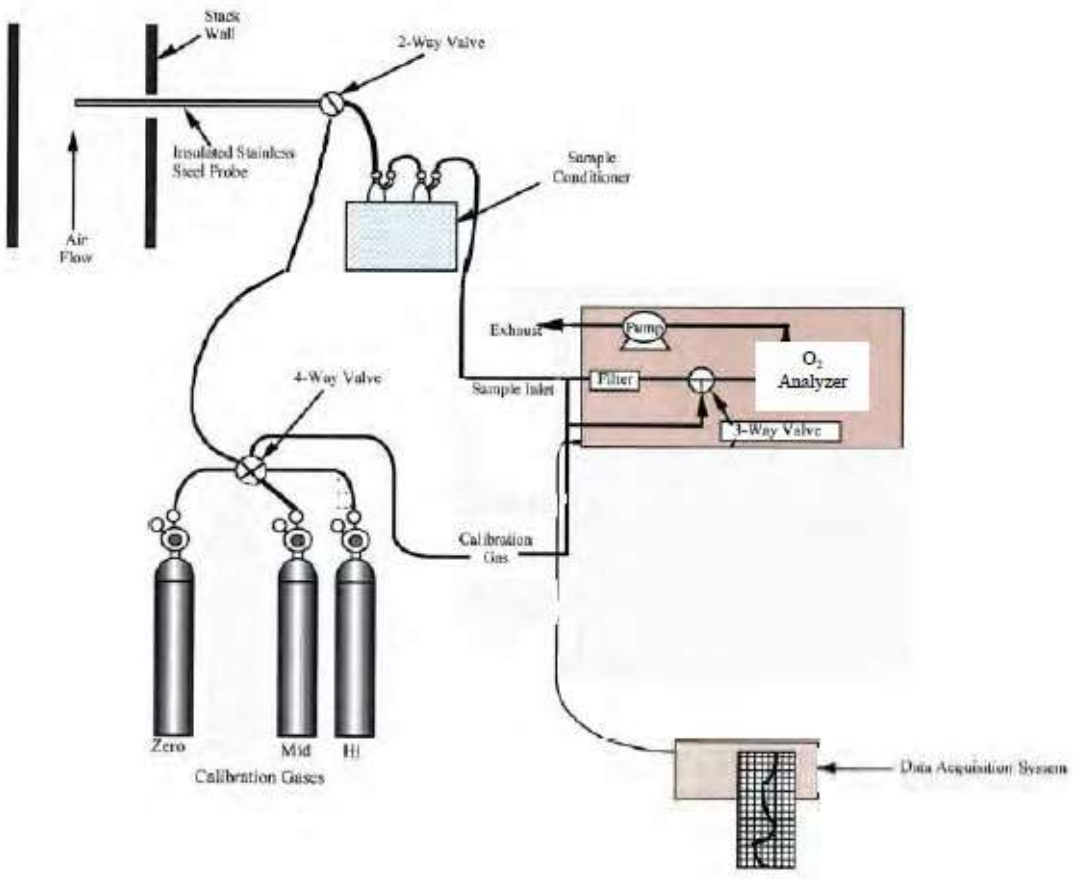


Figure 3. USEPA Method 3A Sampling Train



5. QUALITY ASSURANCE PROCEDURES

Each reference method presented in the U.S. Code of Federal Regulations details the instrument calibration requirements, sample recovery and analysis, data reduction and verification, types of equipment required, and the appropriate sampling and analytical procedures to ensure maximum performance and accuracy. EQM and EQM's affiliates and subcontractors adhere to the guidelines for quality control set forth by the United States Environmental Protection Agency. These procedures are outlined in the following documents:

- Code of Federal Regulations, Title 40, Part 51
- Code of Federal Regulations, Title 40, Part 60
- Quality Assurance Handbook, Volume 1, EPA 600/9-76-005
- Quality Assurance Handbook, Volume 2, EPA 600/4-77-027a
- Quality Assurance Handbook, Volume 3, EPA 600/4-77-027b

6. CONCLUSIONS

An Emissions Test was conducted on the Turbine Unit TR01 at TC Energy's ANR Pipeline Company's LaGrange Compressor Station located in LaGrange, IN. The testing was conducted on August 18, 2022.

During the course of the testing, the Turbine Unit TR01 conformed to the requirements of Code of Federal Regulations, Title 40, Part 63, Subpart YYYY to determine results of H_2CO ppbvd @ 15% O2.

The usefulness and/or significance of the emissions values presented in this document as they relate to the compliance status of the Turbine Unit TR01 emissions shall be determined by others.

For additional information pertaining to the testing program see Appendix D of this report.

A. FIELD TEST DATA

TC Energy ANR Pipeline Co.
LaGrange, IN
TR01
USEPA Methods 3A & 320
FTIR Emissions Testing
August 18th, 2022
PROJ-020063

Scope

Prism Analytical Technologies (Mt. Pleasant, MI) was contracted by Environmental Quality Management, Inc. (Cincinnati, OH) to conduct air emission testing for TC Energy ANR Pipeline Co, LaGrange, IN. Testing was performed August 18th, 2022 to determine concentrations of gaseous formaldehyde (CH_2O), oxygen (O_2), and moisture content (H_2O) from natural gas turbine T01.

US EPA Methods 3A and 320 was performed to quantify the concentration levels of gaseous formaldehyde, oxygen, and moisture content. James Carey (Prism) performed the data collection. Amanda Nilles (Prism) performed report generation and data validation. Phillip Kauppi (Prism) reviewed the FTIR data and report.

Procedures

StarBoost™ FTIR Method 320 Instrumental Configuration & Sample Collection

FTIR data were collected using an MKS MultiGas 2030 FTIR spectrometer configured with a StarBoost system. The StarBoost technology consists of a 5-micron infrared detector, optical filtration and signal amplification. It is designed to optimize signal response and limit instrument noise for low detection limit applications. The FTIR was equipped with a temperature-controlled, 5.11-meter multipass gas cell maintained at 191°C. All data were collected in differential mode with 2 cm-1 resolution sample data and 8 cm-1 resolution background. Each FTIR spectrum was derived from the coaddition of 220 scans, with a new data point generated approximately every 60 seconds.

Sample gas continuously flew through the FTIR gas cell via heated head sampling pump. Total sample flow was approximately eight liters per minute. Gas flow and sampling system pressure were monitored using a rotameter and pressure transducer. See Table 1 below for sampling system details.

Table 1 – FTIR Sampling System

Source	StarBoost Serial #	Sampling Line	Probe Assembly	Particulate Filter Media	Operating Temperatures
TR01	00244	100', 3/8" dia. Teflon	3', 3/8" dia. Inconel + heated filter element	0.01µ borosilicate	191°C FTIR + 150°C system

StarBoost™ FTIR QA/QC Methodology

QA/QC procedures followed US EPA Method 320. See Tables 2 and 3 below for QA/QC procedure details and list of calibration gas standards. All calibration gases were introduced to the analyzer and sampling system using instrument grade stainless steel rotameters. All QA/QC procedures were within the acceptance criteria allowance of the EPA methodology. QA/QC calculations are presented in detail below.

FTIR diagnostics were performed on the instrument daily to ensure signal intensity and line shape were acceptable to make low-level formaldehyde measurements.

Table 2 – FTIR QA/QC Procedures

QAQC Specification	Purpose	Calibration Gas Analyte	Delivery	Frequency	Acceptance Criteria	Result
M320: Zero	Verify that the FTIR is free of contaminants & zero the FTIR	Nitrogen (zero)	Direct to FTIR	pre/post test	< MDL or Noise	**Pass**
M320: Calibration Transfer Standard (CTS) Direct	Verify FTIR stability, confirm optical path length	Methane	Direct to FTIR	pre-test	+/- 5% cert. value	**Pass**
M320: Analyte Direct	Verify FTIR calibration	Formaldehyde, N_2O	Direct to FTIR	pre-test	Determine FTIR response to be used for analyte spike calcs	**Pass**
M320: CTS Response	Verify system stability, recovery, RT	Methane	Sampling System	pre/post test	+/- 5% of Direct Measurement	**Pass**
M320: Zero Response	Verify system is free of contaminants, system bias	Nitrogen (zero)	Sampling System	pre/post test	Bias correct data	**Pass**
M320: Analyte Spike	Verify system ability to deliver and quantify analyte of interest in the presence of other effluent gases	Formaldehyde, N_2O	Dynamic Addition to Sampling System, 1:10 effluent	pre-test	+/- 30% theoretical recovery	**Pass**

Table 3 – Calibration Gas Standards

Components	Concentration (ppm)	Concentration (%)	Vendor	Cylinder #	Standard Type
Formaldehyde, N_2O	0.598, 250.1	-	Airgas	EB0116258	Certified Standard-Spec +/- 5%, 2%
Methane	100.2	-	Airgas	CC22973	Certified Standard-Spec +/- 2 %
O2	-	21.8	Tier 5 Labs	ER0004758	EPA Protocol +/- 0.1% NIST Traceable
O2	-	11.8	Tier 5 Labs	CC664614	EPA Protocol +/- 0.2% NIST Traceable
Nitrogen	Zero gas	Zero gas	Airgas	n/a	UHP Grade

StarBoost™ FTIR QA/QC Calculations

Method 320: Analyte Spiking

Formaldehyde spiking was performed at each source prior to testing to verify the ability of the sampling system to quantitatively deliver a sample containing formaldehyde from the base of the probe to the FTIR. The spike target dilution ratio was 1:10 or less. Analyte spiking assures the ability of the FTIR to quantify formaldehyde in the presence of effluent gas.

As part of the spiking procedure, samples from the source were measured before spiking to determine native concentrations to be used in the spike recovery calculations. The analyte spiking gas contained nitrous oxide (N_2O). The determined N_2O concentration in the spiked sample was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked formaldehyde.

$$DF = \frac{N2O(spk)}{N2O(Direct)}$$

$$CS = DF * Spike(dir) + Unspike(1 - DF) \quad \text{(Sec. 9.3.1 (2) USEPA Method 320)}$$

DF = Dilution factor of the spike gas
$N_2O_{(dir)}$ = N_2O concentration measured directly in undiluted spike gas
$N_2O_{(spk)}$ = Diluted N_2O concentration measured in a spiked sample
$Spike_{dir}$ = Concentration of the analyte in the spike standard measure by the FTIR directly
CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

FTIR Post Collection Data Validation

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within ± 20% agreement. If there is a difference greater than ± 20% the spectra are reviewed for possible spectra interferences or any other potential causes leading to misquantified data.

Oxygen Determination

Oxygen concentrations were determined using a Brand Gaus, Model 4710 Oxygen Analyzer, which utilizes Linear Output Zirconium Oxide Technology. The O_2 analyzer was installed at the exhaust of the FTIR, with all gases passing through the O_2 analyzer. The O_2 analyzer continually measures oxygen as it flows through the system.

QA/QC procedures followed US EPA Method 3A. See Tables 3 and 4 for list of calibration gas standards and QA/QC procedure details. All calibration gases were introduced to the analyzer and the sampling system using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable US EPA methodology. See the Oxygen Analyzer Data Appendices for numerical results.

Table 4 – Oxygen QA/QC Procedures

QAQC Specification	Purpose	Calibration Gas Analyte	Delivery	Frequency	Acceptance Criteria	Result
M3A: Zero	Zero the analyzer	Nitrogen (zero)	Direct to O2 Analyzer	pretest	< MDL or Noise	**Pass**
M3A: Span	Establish the upper range of the analyzer	21.8 % O2	Direct to O2 Analyzer	pretest	+/- 2% cert. value	**Pass**
M3A: MidPoint	Confirm linear response	11.8 % O2	Direct to O2 Analyzer	pretest	+/- 2% cert. value	**Pass**
M3A: System Zero	Verify system Bias & Drift / leak check	Nitrogen / Methane (zero)	Sampling System	pre/post test run	< 5% Bias < 3% Drift	**Pass**
M3A: System MidPoint	Verify system Bias & Drift / leak check	11.8 % O2	Sampling System	pre/post test run	< 5% Bias < 3% Drift	**Pass**

Results and Discussion

Detection Limit

The StarBoost™ FTIR detection limit for each analyte was calculated following Annex A2 of ASTM D6348-12 procedure using spectra that contained similar amounts of moisture. The minimum detectable concentration of formaldehyde was calculated as three times the standard deviation of the noise in the FTIR system. This minimum concentration can be detected with a probability of 99.7 %. See Table 4 below for determined minimum detectable concentrations.

Table 4 - StarBoost™ FTIR Detection Limits

Analyte	Detection Limit (ppmv wet)	Detection Limit (%v wet)
Formaldehyde	0.02	-
H_2O	-	0.1
O_2	-	0.1

TR01

Three, sixty-minute test runs were performed on TR01. Testing was performed on August 18th, 2022. All Method 320 FTIR data concentration data were determined on a wet concentration (ppmvw) volume basis. The determined moisture and oxygen levels were used to calculate formaldehyde on a ppb dry, corrected to 15% O2 value.

Analyte spiking was performed to confirm the ability of the measurement system to deliver and quantify formaldehyde. See the FTIR QA/QC Data and Run Results Appendix for all concentration results. See Tables 5 below for a summary of test run results.

Table 5 – TR01 – Run Summary

Condition	Calculation	Formaldehyde (ppmv wet)	H2O (%v)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)	O2 Corrected (%v dry)	Formaldehyde Corrected (ppbv dry @ 15% O2)
TR01 - Run 1 8/18/2022 9:40 - 9:57, 10:19 - 11:01	Minimum	0.045	6.52	14.41	0.048	15.48	15.86	91
	Maximum	0.096	6.93	14.70	0.103	15.75		
	Average	0.072	6.70	14.64	0.078	15.69		
TR01 - Run 2 8/18/2022 11:20 - 12:20	Minimum	0.046	6.41	14.65	0.050	15.70	15.43	74
	Maximum	0.083	6.74	14.73	0.088	15.75		
	Average	0.064	6.56	14.69	0.069	15.72		
TR01 - Run 3 8/18/2022 12:35 - 13:35	Minimum	0.041	6.28	14.70	0.043	15.70	15.45	70
	Maximum	0.078	6.46	14.76	0.083	15.77		
	Average	0.061	6.39	14.73	0.065	15.74		

The following Appendices are included:

- Test Run Data
- FTIR & O_2 QA/QC Data
- Certificates of Analysis

Amanda Nilles
Field Technician / Chemist
EQM_ANRPipelineCo_LaGrangeIN_2022Aug_PROJ-020063_txt

Date: September 15, 2022

APPENDIX

Test Run Data

TR01 - Test Run 1

Spectrum	Date	Time	Formaldehyde (ppmv wet)	H2O (%v)	FTIR Gas Cell Temperature (°C)	FTIR Gas Cell Pressure (atm)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)
ENG_0192.LAB	8/18/2022	9:40:53	0.087	6.86	190.9	0.999	14.58	0.094	15.66
ENG_0193.LAB	8/18/2022	9:41:53	0.094	6.88	190.9	0.999	14.56	0.101	15.63
ENG_0194.LAB	8/18/2022	9:42:53	0.096	6.90	190.9	0.999	14.54	0.103	15.62
ENG_0195.LAB	8/18/2022	9:43:52	0.085	6.87	190.9	1.000	14.58	0.091	15.66
ENG_0196.LAB	8/18/2022	9:44:52	0.092	6.91	191.0	0.999	14.53	0.099	15.61
ENG_0197.LAB	8/18/2022	9:45:52	0.080	6.89	190.9	0.998	14.58	0.086	15.65
ENG_0198.LAB	8/18/2022	9:46:52	0.092	6.87	191.0	0.999	14.58	0.099	15.65
ENG_0199.LAB	8/18/2022	9:47:52	0.087	6.89	191.0	0.999	14.58	0.094	15.66
ENG_0200.LAB	8/18/2022	9:48:52	0.083	6.89	191.1	0.999	14.50	0.089	15.58
ENG_0201.LAB	8/18/2022	9:49:51	0.088	6.90	191.0	0.999	14.57	0.094	15.65
ENG_0202.LAB	8/18/2022	9:50:51	0.087	6.88	191.1	0.999	14.58	0.093	15.66
ENG_0203.LAB	8/18/2022	9:51:51	0.085	6.84	191.0	1.000	14.61	0.091	15.68
ENG_0204.LAB	8/18/2022	9:52:51	0.070	6.84	191.0	1.000	14.62	0.075	15.70
ENG_0205.LAB	8/18/2022	9:53:51	0.069	6.82	190.9	0.999	14.63	0.074	15.70
ENG_0206.LAB	8/18/2022	9:54:50	0.084	6.78	190.9	0.999	14.63	0.090	15.69
ENG_0207.LAB	8/18/2022	9:55:50	0.075	6.82	190.9	0.999	14.65	0.080	15.73
ENG_0208.LAB	8/18/2022	9:56:50	0.083	6.76	190.9	1.000	14.65	0.089	15.71
ENG_0209.LAB	8/18/2022	9:57:50	0.067	6.76	190.8	0.999	14.65	0.072	15.72
ENG_0213.LAB	8/18/2022	10:19:46	0.072	6.93	190.8	0.997	14.41	0.077	15.48
ENG_0214.LAB	8/18/2022	10:20:46	0.069	6.86	190.8	0.999	14.46	0.074	15.53
ENG_0215.LAB	8/18/2022	10:21:46	0.087	6.81	190.8	0.998	14.54	0.094	15.60
ENG_0216.LAB	8/18/2022	10:22:45	0.083	6.77	190.8	0.998	14.55	0.089	15.61
ENG_0217.LAB	8/18/2022	10:23:45	0.079	6.71	190.8	0.998	14.57	0.085	15.62
ENG_0218.LAB	8/18/2022	10:24:45	0.080	6.70	190.8	0.999	14.58	0.086	15.63
ENG_0219.LAB	8/18/2022	10:25:45	0.076	6.68	190.8	0.998	14.61	0.081	15.66
ENG_0220.LAB	8/18/2022	10:26:45	0.078	6.62	190.8	0.998	14.64	0.084	15.67
ENG_0221.LAB	8/18/2022	10:27:44	0.076	6.60	190.8	0.998	14.62	0.082	15.66
ENG_0222.LAB	8/18/2022	10:28:44	0.057	6.61	190.8	0.997	14.66	0.061	15.70
ENG_0223.LAB	8/18/2022	10:29:44	0.063	6.58	190.8	0.998	14.66	0.068	15.69
ENG_0224.LAB	8/18/2022	10:30:44	0.072	6.58	190.8	1.000	14.66	0.077	15.69
ENG_0225.LAB	8/18/2022	10:31:44	0.052	6.62	190.8	0.999	14.67	0.056	15.71
ENG_0226.LAB	8/18/2022	10:32:44	0.080	6.57	190.8	0.998	14.66	0.085	15.69
ENG_0227.LAB	8/18/2022	10:33:43	0.071	6.57	190.8	0.999	14.66	0.076	15.69
ENG_0228.LAB	8/18/2022	10:34:43	0.062	6.58	190.8	0.999	14.69	0.066	15.72
ENG_0229.LAB	8/18/2022	10:35:43	0.078	6.52	190.8	0.999	14.68	0.084	15.70
ENG_0230.LAB	8/18/2022	10:36:43	0.064	6.54	190.8	0.998	14.70	0.068	15.72
ENG_0231.LAB	8/18/2022	10:37:43	0.055	6.54	190.8	1.000	14.69	0.058	15.72
ENG_0232.LAB	8/18/2022	10:38:43	0.070	6.54	190.8	1.000	14.70	0.075	15.72
ENG_0233.LAB	8/18/2022	10:39:42	0.060	6.57	190.8	0.999	14.68	0.065	15.71
ENG_0234.LAB	8/18/2022	10:40:42	0.065	6.58	190.8	0.999	14.69	0.070	15.72
ENG_0235.LAB	8/18/2022	10:41:42	0.058	6.67	190.8	0.999	14.68	0.062	15.73
ENG_0236.LAB	8/18/2022	10:42:42	0.064	6.63	190.8	1.000	14.68	0.069	15.72
ENG_0237.LAB	8/18/2022	10:43:42	0.077	6.58	190.8	0.999	14.69	0.083	15.72
ENG_0238.LAB	8/18/2022	10:44:41	0.068	6.57	190.8	0.999	14.68	0.073	15.71
ENG_0239.LAB	8/18/2022	10:45:41	0.075	6.60	190.8	1.001	14.70	0.081	15.73
ENG_0240.LAB	8/18/2022	10:46:41	0.072	6.59	190.8	1.000	14.67	0.077	15.71
ENG_0241.LAB	8/18/2022	10:47:41	0.070	6.62	190.8	1.000	14.68	0.075	15.72
ENG_0242.LAB	8/18/2022	10:48:41	0.063	6.67	190.8	0.999	14.69	0.068	15.74
ENG_0243.LAB	8/18/2022	10:49:41	0.064	6.64	190.8	0.999	14.69	0.069	15.73
ENG_0244.LAB	8/18/2022	10:50:40	0.078	6.69	190.8	0.999	14.70	0.084	15.75
ENG_0245.LAB	8/18/2022	10:51:40	0.069	6.67	190.8	1.000	14.69	0.074	15.74
ENG_0246.LAB	8/18/2022	10:52:40	0.057	6.67	190.8	0.999	14.68	0.062	15.73
ENG_0247.LAB	8/18/2022	10:53:40	0.056	6.68	190.8	0.999	14.67	0.060	15.72
ENG_0248.LAB	8/18/2022	10:54:40	0.064	6.68	190.8	1.001	14.70	0.069	15.75
ENG_0249.LAB	8/18/2022	10:55:40	0.058	6.65	190.8	1.000	14.66	0.062	15.71
ENG_0250.LAB	8/18/2022	10:56:40	0.069	6.64	190.8	1.000	14.70	0.074	15.74
ENG_0251.LAB	8/18/2022	10:57:39	0.070	6.66	190.8	1.000	14.69	0.075	15.73

Spectrum	Date	Time	Formaldehyde (ppmv wet)	H2O (%v)	FTIR Gas Cell Temperature (°C)	FTIR Gas Cell Pressure (atm)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)
ENG_0252.LAB	8/18/2022	10:58:39	0.059	6.64	190.8	0.998	14.70	0.063	15.74
ENG_0253.LAB	8/18/2022	10:59:39	0.049	6.61	190.8	1.000	14.70	0.052	15.73
ENG_0254.LAB	8/18/2022	11:00:39	0.045	6.59	190.8	1.000	14.69	0.048	15.72
ENG_0255.LAB	8/18/2022	11:01:39	0.081	6.61	190.8	1.000	14.70	0.086	15.74
TR01 - Run 1	**Minimum**		**0.045**	**6.52**	**190.8**	**0.997**	**14.41**	**0.048**	**15.48**
8/18/2022	**Maximum**		**0.096**	**6.93**	**191.1**	**1.001**	**14.70**	**0.103**	**15.75**
9:40 - 9:57, 10:19 - 11:01	**Average**		**0.072**	**6.70**	**190.8**	**0.999**	**14.64**	**0.078**	**15.69**

TR01 - Test Run 2

Spectrum	Date	Time	Formaldehyde (ppmv wet)	H2O (%v)	FTIR Gas Cell Temperature (°C)	FTIR Gas Cell Pressure (atm)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)
ENG_0289.LAB	8/18/2022	11:20:04	0.056	6.71	190.8	0.996	14.65	0.060	15.70
ENG_0290.LAB	8/18/2022	11:21:04	0.064	6.69	190.8	0.997	14.66	0.069	15.71
ENG_0291.LAB	8/18/2022	11:22:04	0.064	6.69	190.8	0.996	14.66	0.069	15.72
ENG_0292.LAB	8/18/2022	11:23:04	0.070	6.69	190.8	0.996	14.67	0.075	15.72
ENG_0293.LAB	8/18/2022	11:24:04	0.050	6.74	190.8	0.998	14.66	0.054	15.72
ENG_0294.LAB	8/18/2022	11:25:03	0.060	6.70	190.8	0.997	14.66	0.064	15.71
ENG_0295.LAB	8/18/2022	11:26:03	0.081	6.62	190.8	0.998	14.69	0.087	15.73
ENG_0296.LAB	8/18/2022	11:27:03	0.065	6.65	190.8	0.997	14.67	0.069	15.72
ENG_0297.LAB	8/18/2022	11:28:03	0.052	6.65	190.8	0.996	14.68	0.056	15.73
ENG_0298.LAB	8/18/2022	11:29:03	0.067	6.68	190.8	0.997	14.66	0.072	15.71
ENG_0299.LAB	8/18/2022	11:30:03	0.051	6.65	190.8	0.998	14.70	0.054	15.74
ENG_0300.LAB	8/18/2022	11:31:02	0.070	6.66	190.8	0.998	14.67	0.075	15.72
ENG_0301.LAB	8/18/2022	11:32:02	0.083	6.58	190.8	0.997	14.69	0.088	15.72
ENG_0302.LAB	8/18/2022	11:33:02	0.068	6.62	190.9	0.997	14.69	0.072	15.73
ENG_0303.LAB	8/18/2022	11:34:02	0.074	6.61	191.0	0.997	14.67	0.080	15.71
ENG_0304.LAB	8/18/2022	11:35:02	0.059	6.63	191.0	0.997	14.69	0.064	15.73
ENG_0305.LAB	8/18/2022	11:36:02	0.053	6.53	191.0	0.998	14.70	0.057	15.72
ENG_0306.LAB	8/18/2022	11:37:01	0.079	6.50	191.0	0.998	14.70	0.085	15.73
ENG_0307.LAB	8/18/2022	11:38:01	0.069	6.55	191.0	0.999	14.70	0.073	15.73
ENG_0308.LAB	8/18/2022	11:39:01	0.067	6.47	191.0	0.999	14.70	0.072	15.72
ENG_0309.LAB	8/18/2022	11:40:01	0.059	6.54	191.0	0.998	14.70	0.064	15.73
ENG_0310.LAB	8/18/2022	11:41:01	0.068	6.59	191.0	0.999	14.69	0.073	15.72
ENG_0311.LAB	8/18/2022	11:42:00	0.059	6.55	191.0	0.999	14.70	0.063	15.73
ENG_0312.LAB	8/18/2022	11:43:00	0.056	6.51	191.0	0.998	14.70	0.060	15.73
ENG_0313.LAB	8/18/2022	11:44:00	0.057	6.54	191.0	0.998	14.70	0.060	15.73
ENG_0314.LAB	8/18/2022	11:45:00	0.066	6.58	191.0	0.998	14.69	0.071	15.72
ENG_0315.LAB	8/18/2022	11:46:00	0.073	6.54	191.1	0.999	14.70	0.078	15.72
ENG_0316.LAB	8/18/2022	11:47:00	0.060	6.46	191.1	0.999	14.70	0.064	15.72
ENG_0317.LAB	8/18/2022	11:47:59	0.073	6.51	191.0	1.000	14.68	0.078	15.70
ENG_0318.LAB	8/18/2022	11:48:59	0.081	6.58	191.1	0.999	14.69	0.087	15.72
ENG_0319.LAB	8/18/2022	11:49:59	0.061	6.55	191.1	1.000	14.69	0.066	15.72
ENG_0320.LAB	8/18/2022	11:50:59	0.055	6.58	191.1	0.998	14.68	0.059	15.71
ENG_0321.LAB	8/18/2022	11:51:59	0.069	6.52	191.1	0.998	14.70	0.074	15.73
ENG_0322.LAB	8/18/2022	11:52:59	0.066	6.48	191.1	0.999	14.71	0.070	15.73
ENG_0323.LAB	8/18/2022	11:53:58	0.062	6.51	191.1	0.999	14.69	0.066	15.71
ENG_0324.LAB	8/18/2022	11:55:13	0.064	6.58	191.1	0.999	14.70	0.069	15.73
ENG_0325.LAB	8/18/2022	11:56:15	0.068	6.52	191.1	0.998	14.70	0.073	15.73
ENG_0326.LAB	8/18/2022	11:57:15	0.062	6.64	191.1	0.998	14.70	0.067	15.74
ENG_0327.LAB	8/18/2022	11:58:42	0.074	6.56	191.1	0.998	14.70	0.079	15.74
ENG_0328.LAB	8/18/2022	11:59:42	0.066	6.58	191.1	0.999	14.70	0.071	15.74
ENG_0329.LAB	8/18/2022	12:00:42	0.076	6.56	191.0	0.999	14.70	0.082	15.73
ENG_0330.LAB	8/18/2022	12:01:42	0.060	6.60	191.0	0.999	14.71	0.064	15.75
ENG_0331.LAB	8/18/2022	12:02:43	0.073	6.56	191.0	0.999	14.70	0.078	15.73
ENG_0332.LAB	8/18/2022	12:03:43	0.057	6.53	191.0	0.999	14.70	0.061	15.72
ENG_0333.LAB	8/18/2022	12:04:42	0.048	6.57	191.0	0.999	14.71	0.052	15.74
ENG_0334.LAB	8/18/2022	12:05:42	0.047	6.53	191.0	0.998	14.68	0.050	15.70
ENG_0335.LAB	8/18/2022	12:06:42	0.046	6.53	191.1	0.999	14.69	0.050	15.71
ENG_0336.LAB	8/18/2022	12:07:42	0.057	6.45	191.0	0.999	14.71	0.061	15.73
ENG_0337.LAB	8/18/2022	12:08:42	0.058	6.46	191.1	0.998	14.70	0.062	15.72
ENG_0338.LAB	8/18/2022	12:09:42	0.048	6.43	191.0	0.999	14.70	0.052	15.70
ENG_0339.LAB	8/18/2022	12:10:42	0.065	6.48	191.0	0.998	14.72	0.069	15.74
ENG_0340.LAB	8/18/2022	12:11:42	0.075	6.42	191.0	0.997	14.71	0.080	15.72

Spectrum	Date	Time	Formaldehyde (ppmv wet)	H2O (%v)	FTIR Gas Cell Temperature (°C)	FTIR Gas Cell Pressure (atm)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)
ENG_0341.LAB	8/18/2022	12:12:41	0.060	6.45	191.0	1.000	14.70	0.064	15.71
ENG_0342.LAB	8/18/2022	12:13:41	0.067	6.52	191.0	0.999	14.73	0.072	15.75
ENG_0343.LAB	8/18/2022	12:14:41	0.057	6.48	191.0	0.999	14.73	0.061	15.75
ENG_0344.LAB	8/18/2022	12:15:41	0.065	6.50	191.0	0.999	14.70	0.070	15.72
ENG_0345.LAB	8/18/2022	12:16:41	0.061	6.50	191.0	0.997	14.70	0.065	15.72
ENG_0346.LAB	8/18/2022	12:17:41	0.069	6.41	191.0	0.999	14.72	0.074	15.73
ENG_0347.LAB	8/18/2022	12:18:40	0.077	6.45	191.1	0.999	14.73	0.082	15.75
ENG_0348.LAB	8/18/2022	12:19:40	0.073	6.48	191.1	0.999	14.72	0.078	15.74
ENG_0349.LAB	8/18/2022	12:20:41	0.064	6.45	191.1	0.999	14.71	0.069	15.73
TR01 - Run 2	**Minimum**		**0.046**	**6.41**	**190.8**	**0.996**	**14.65**	**0.050**	**15.70**
8/18/2022	**Maximum**		**0.083**	**6.74**	**191.1**	**1.000**	**14.73**	**0.088**	**15.75**
11:20 - 12:20	**Average**		**0.064**	**6.56**	**191.0**	**0.998**	**14.69**	**0.069**	**15.72**

TR01 - Test Run 3

Spectrum	Date	Time	Formaldehyde (ppmv wet)	H2O (%v)	FTIR Gas Cell Temperature (°C)	FTIR Gas Cell Pressure (atm)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)
ENG_0383.LAB	8/18/2022	12:35:27	0.064	6.42	191.0	0.994	14.73	0.068	15.74
ENG_0384.LAB	8/18/2022	12:36:26	0.059	6.37	191.0	0.996	14.73	0.063	15.73
ENG_0385.LAB	8/18/2022	12:37:26	0.059	6.38	191.0	0.995	14.75	0.063	15.76
ENG_0386.LAB	8/18/2022	12:38:26	0.066	6.38	191.0	0.996	14.73	0.071	15.73
ENG_0387.LAB	8/18/2022	12:39:26	0.064	6.45	191.0	0.995	14.73	0.069	15.74
ENG_0388.LAB	8/18/2022	12:40:26	0.064	6.42	191.0	0.995	14.73	0.068	15.74
ENG_0389.LAB	8/18/2022	12:41:25	0.065	6.42	191.0	0.995	14.73	0.069	15.74
ENG_0390.LAB	8/18/2022	12:42:25	0.043	6.40	191.0	0.995	14.73	0.046	15.74
ENG_0391.LAB	8/18/2022	12:43:25	0.063	6.42	191.0	0.997	14.72	0.067	15.73
ENG_0392.LAB	8/18/2022	12:44:25	0.061	6.46	191.0	0.995	14.72	0.065	15.73
ENG_0393.LAB	8/18/2022	12:45:25	0.066	6.41	191.0	0.996	14.73	0.071	15.74
ENG_0394.LAB	8/18/2022	12:46:25	0.055	6.39	191.0	0.996	14.73	0.058	15.73
ENG_0395.LAB	8/18/2022	12:47:24	0.068	6.35	191.0	0.996	14.74	0.072	15.74
ENG_0396.LAB	8/18/2022	12:48:24	0.059	6.41	191.0	0.997	14.71	0.063	15.72
ENG_0397.LAB	8/18/2022	12:49:24	0.041	6.43	191.0	0.997	14.73	0.043	15.74
ENG_0398.LAB	8/18/2022	12:50:24	0.065	6.43	191.0	0.997	14.72	0.069	15.73
ENG_0399.LAB	8/18/2022	12:51:24	0.051	6.43	191.0	0.997	14.71	0.055	15.72
ENG_0400.LAB	8/18/2022	12:52:24	0.069	6.43	191.0	0.997	14.72	0.074	15.73
ENG_0401.LAB	8/18/2022	12:53:23	0.065	6.39	191.0	0.998	14.73	0.070	15.74
ENG_0402.LAB	8/18/2022	12:54:23	0.058	6.45	191.0	0.996	14.71	0.062	15.72
ENG_0403.LAB	8/18/2022	12:55:23	0.064	6.44	191.0	0.997	14.74	0.069	15.75
ENG_0404.LAB	8/18/2022	12:56:23	0.072	6.38	191.0	0.997	14.72	0.077	15.72
ENG_0405.LAB	8/18/2022	12:57:23	0.070	6.39	191.0	0.996	14.73	0.075	15.74
ENG_0406.LAB	8/18/2022	12:58:23	0.054	6.43	191.0	0.998	14.73	0.057	15.75
ENG_0407.LAB	8/18/2022	12:59:22	0.056	6.44	191.0	0.997	14.73	0.060	15.75
ENG_0408.LAB	8/18/2022	13:00:22	0.058	6.40	191.0	0.996	14.73	0.062	15.74
ENG_0409.LAB	8/18/2022	13:01:22	0.052	6.42	191.0	0.997	14.73	0.055	15.74
ENG_0410.LAB	8/18/2022	13:02:22	0.069	6.38	191.0	0.998	14.74	0.074	15.75
ENG_0411.LAB	8/18/2022	13:03:22	0.061	6.37	191.0	0.997	14.73	0.065	15.74
ENG_0412.LAB	8/18/2022	13:04:21	0.042	6.40	191.0	0.999	14.72	0.045	15.72
ENG_0413.LAB	8/18/2022	13:05:21	0.053	6.43	191.0	0.997	14.73	0.056	15.75
ENG_0414.LAB	8/18/2022	13:06:21	0.057	6.42	191.0	0.998	14.71	0.061	15.72
ENG_0415.LAB	8/18/2022	13:07:21	0.061	6.38	191.0	0.998	14.74	0.065	15.75
ENG_0416.LAB	8/18/2022	13:08:21	0.069	6.38	191.0	0.998	14.73	0.073	15.74
ENG_0417.LAB	8/18/2022	13:09:21	0.071	6.32	191.0	0.998	14.75	0.076	15.75
ENG_0418.LAB	8/18/2022	13:10:20	0.073	6.39	191.0	0.998	14.73	0.078	15.74
ENG_0419.LAB	8/18/2022	13:11:20	0.054	6.35	191.0	0.999	14.75	0.058	15.75
ENG_0420.LAB	8/18/2022	13:12:20	0.065	6.38	191.0	0.998	14.73	0.070	15.74
ENG_0421.LAB	8/18/2022	13:13:20	0.070	6.39	191.0	0.998	14.75	0.075	15.76
ENG_0422.LAB	8/18/2022	13:14:20	0.068	6.43	191.0	0.999	14.73	0.073	15.74
ENG_0423.LAB	8/18/2022	13:15:20	0.073	6.46	191.0	0.998	14.75	0.078	15.77

Spectrum	Date	Time	Formaldehyde (ppmv wet)	H2O (%v)	FTIR Gas Cell Temperature (°C)	FTIR Gas Cell Pressure (atm)	O2 (%v wet)	Formaldehyde (ppmv dry)	O2 (%v dry)
ENG_0424.LAB	8/18/2022	13:16:19	0.055	6.38	191.0	0.999	14.74	0.059	15.74
ENG_0425.LAB	8/18/2022	13:17:19	0.062	6.35	191.0	0.998	14.74	0.066	15.74
ENG_0426.LAB	8/18/2022	13:18:19	0.044	6.37	190.9	0.997	14.75	0.047	15.75
ENG_0427.LAB	8/18/2022	13:19:19	0.060	6.40	191.0	0.999	14.74	0.064	15.75
ENG_0428.LAB	8/18/2022	13:20:19	0.054	6.37	191.0	0.998	14.74	0.058	15.74
ENG_0429.LAB	8/18/2022	13:21:18	0.059	6.36	191.0	0.998	14.76	0.063	15.76
ENG_0430.LAB	8/18/2022	13:22:18	0.054	6.34	190.9	0.999	14.75	0.058	15.75
ENG_0431.LAB	8/18/2022	13:23:18	0.077	6.28	190.9	0.999	14.76	0.082	15.75
ENG_0432.LAB	8/18/2022	13:24:18	0.078	6.30	191.0	0.998	14.74	0.083	15.73
ENG_0433.LAB	8/18/2022	13:25:18	0.055	6.31	191.0	0.998	14.73	0.059	15.72
ENG_0434.LAB	8/18/2022	13:26:17	0.044	6.39	191.0	0.998	14.73	0.047	15.74
ENG_0435.LAB	8/18/2022	13:27:17	0.050	6.34	191.0	0.998	14.73	0.054	15.72
ENG_0436.LAB	8/18/2022	13:28:17	0.060	6.36	191.0	0.997	14.74	0.064	15.74
ENG_0437.LAB	8/18/2022	13:29:17	0.064	6.33	191.0	0.998	14.76	0.068	15.75
ENG_0438.LAB	8/18/2022	13:30:17	0.059	6.33	190.9	0.998	14.75	0.063	15.75
ENG_0439.LAB	8/18/2022	13:31:17	0.060	6.35	190.9	0.998	14.71	0.064	15.71
ENG_0440.LAB	8/18/2022	13:32:16	0.069	6.36	190.9	0.998	14.70	0.074	15.70
ENG_0441.LAB	8/18/2022	13:33:16	0.063	6.38	191.0	0.999	14.72	0.067	15.72
ENG_0442.LAB	8/18/2022	13:34:16	0.059	6.35	191.0	0.998	14.73	0.063	15.73
ENG_0443.LAB	8/18/2022	13:35:16	0.062	6.31	190.99	0.999	14.72	0.066	15.71
TR01 - Run 3	**Minimum**		**0.041**	**6.28**	**190.9**	**0.994**	**14.70**	**0.043**	**15.70**
8/18/2022	**Maximum**		**0.078**	**6.46**	**191.0**	**0.999**	**14.76**	**0.083**	**15.77**
12:35 - 13:35	**Average**		**0.061**	**6.39**	**191.0**	**0.997**	**14.73**	**0.065**	**15.74**

APPENDIX

FTIR & O2 QA/QC Data

Nitrogen (Zero) Direct Purge to FTIR

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
N2_DIR_0015.LAB	8/18/2022	8:11:20	0.07	0.032	0.00	0.69	0.05
N2_DIR_0016.LAB	8/18/2022	8:11:35	-0.33	-0.005	-0.01	0.03	0.04
N2_DIR_0017.LAB	8/18/2022	8:11:50	0.07	-0.004	-0.04	0.27	0.05
N2_DIR_0018.LAB	8/18/2022	8:12:05	0.06	0.006	-0.02	0.22	0.04
N2_DIR_0019.LAB	8/18/2022	8:12:20	-0.26	0.010	-0.02	-0.08	0.04
N2_DIR_0020.LAB	8/18/2022	8:12:35	-0.30	0.013	-0.02	0.60	0.04
N2_DIR_0021.LAB	8/18/2022	8:12:50	-0.18	0.030	-0.04	0.20	0.05
N2_DIR_0022.LAB	8/18/2022	8:13:05	-0.54	0.027	-0.02	0.03	0.04
Average							**0.04**

CTS, 100.2 ppm Methane Direct Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	Methane Recovery %
CTS_DIR_0023.LAB	8/18/2022	8:14:15	101.57	-0.076	0.54	-1.78	0.05	**101.4%**
CTS_DIR_0024.LAB	8/18/2022	8:14:30	102.04	-0.074	0.57	-1.40	-2.98	**101.8%**
CTS_DIR_0025.LAB	8/18/2022	8:14:45	101.79	-0.086	0.53	-2.01	-2.98	**101.6%**
CTS_DIR_0026.LAB	8/18/2022	8:15:00	102.30	-0.079	0.55	-1.76	-2.98	**102.1%**
CTS_DIR_0027.LAB	8/18/2022	8:15:15	101.82	-0.088	0.56	-1.85	-2.98	**101.6%**
CTS_DIR_0028.LAB	8/18/2022	8:15:30	101.02	-0.100	0.53	-1.59	-2.98	**100.8%**
CTS_DIR_0029.LAB	8/18/2022	8:15:45	101.75	-0.096	0.55	-2.06	-2.98	**101.5%**
CTS_DIR_0030.LAB	8/18/2022	8:16:00	102.23	-0.103	0.56	-2.16	-2.98	**102.0%**
Average			**101.82**					

21.8% O2 Direct Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %
O2HIGH_DIR_0091.LAB	8/18/2022	8:34:48	0.23	0.040	-0.03	0.42	21.75	**99.8%**
O2HIGH_DIR_0092.LAB	8/18/2022	8:35:03	0.14	0.005	-0.04	0.30	21.75	**99.8%**
O2HIGH_DIR_0093.LAB	8/18/2022	8:35:18	-0.17	0.016	0.00	0.70	21.75	**99.8%**
O2HIGH_DIR_0094.LAB	8/18/2022	8:35:33	-0.37	0.002	-0.03	0.27	21.75	**99.7%**
O2HIGH_DIR_0095.LAB	8/18/2022	8:35:48	-0.44	0.011	0.00	0.44	21.74	**99.7%**
O2HIGH_DIR_0096.LAB	8/18/2022	8:36:03	0.21	0.032	0.00	0.40	21.74	**99.7%**
O2HIGH_DIR_0097.LAB	8/18/2022	8:36:18	-0.20	0.009	0.02	0.26	21.73	**99.7%**
O2HIGH_DIR_0098.LAB	8/18/2022	8:36:33	-0.34	0.037	0.00	-0.06	21.73	**99.7%**
Average							**21.74**	

11.8% O2 Direct Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %
O2MID_DIR_0100.LAB	8/18/2022	8:39:08	0.02	0.022	-0.01	0.20	11.87	**100.6%**
O2MID_DIR_0101.LAB	8/18/2022	8:39:23	0.00	0.016	0.01	0.21	11.87	**100.6%**
O2MID_DIR_0102.LAB	8/18/2022	8:39:38	0.28	0.029	0.00	0.26	11.87	**100.6%**
O2MID_DIR_0103.LAB	8/18/2022	8:39:53	-0.21	0.023	0.03	0.08	11.87	**100.6%**
O2MID_DIR_0104.LAB	8/18/2022	8:40:08	-0.07	0.009	-0.01	0.04	11.86	**100.5%**
O2MID_DIR_0105.LAB	8/18/2022	8:40:23	-0.11	0.017	0.01	0.83	11.86	**100.5%**
O2MID_DIR_0106.LAB	8/18/2022	8:40:38	-0.60	0.004	-0.03	0.32	11.86	**100.5%**
O2MID_DIR_0107.LAB	8/18/2022	8:40:52	0.66	0.011	0.03	-0.15	11.86	**100.5%**
Average							**11.87**	

0.598 ppm Formaldehyde / 250.1 ppm N2O Direct Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
HCHO_DIR_0067.LAB	8/18/2022	8:25:47	-0.59	0.630	-0.05	240.73	0.06
HCHO_DIR_0068.LAB	8/18/2022	8:26:02	0.06	0.581	-0.05	240.19	0.06
HCHO_DIR_0069.LAB	8/18/2022	8:26:17	-0.19	0.591	-0.08	240.18	0.06
HCHO_DIR_0070.LAB	8/18/2022	8:26:32	-0.59	0.600	-0.05	239.96	0.06
HCHO_DIR_0071.LAB	8/18/2022	8:26:47	-0.23	0.624	-0.04	240.48	0.06
HCHO_DIR_0072.LAB	8/18/2022	8:27:02	-0.25	0.636	-0.09	241.15	0.06
HCHO_DIR_0073.LAB	8/18/2022	8:27:17	0.26	0.608	-0.03	239.84	0.06
HCHO_DIR_0074.LAB	8/18/2022	8:27:32	-0.12	0.598	-0.07	240.41	0.06
Average				**0.608**		**240.37**	**0.06**

100.2 ppm Methane System Purge and Response Time Test

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	Methane Recovery %	Response Time (sec)
ENG_CTS_RT_0108.LAB	8/18/2022	8:55:16	-0.54	0.189	6.83	-1.72	14.89	**-0.5%**	-
ENG_CTS_RT_0109.LAB	8/18/2022	8:55:31	50.79	0.000	3.43	-2.24	0.18	**49.9%**	**15**
ENG_CTS_RT_0110.LAB	8/18/2022	8:55:46	101.76	-0.053	0.33	-1.50	0.09	**99.9%**	**30**
ENG_CTS_RT_0111.LAB	8/18/2022	8:56:01	102.13	-0.104	0.31	-1.47	0.08	**100.3%**	
ENG_CTS_RT_0112.LAB	8/18/2022	8:56:16	101.82	-0.097	0.34	-1.51	0.07	**100.0%**	
ENG_CTS_RT_0113.LAB	8/18/2022	8:56:31	102.44	-0.091	0.36	-1.87	0.07	**100.6%**	
ENG_CTS_RT_0114.LAB	8/18/2022	8:56:46	102.68	-0.070	0.38	-1.83	0.07	**100.8%**	
ENG_CTS_RT_0115.LAB	8/18/2022	8:57:01	102.60	-0.077	0.38	-1.88	0.06	**100.8%**	
ENG_CTS_RT_0116.LAB	8/18/2022	8:57:16	102.39	-0.091	0.36	-2.01	0.06	**100.6%**	
ENG_CTS_RT_0117.LAB	8/18/2022	8:57:31	101.87	-0.065	0.32	-1.37	0.06	**100.1%**	
Average			**102.28**						

11.8% O2 System Purge and Response Time Test

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %	Response Time (sec)
ENG_O2MID_RT_0119.LAB	8/18/2022	8:58:24	101.88	-0.077	0.26	-1.06	0.05	**0.4%**	-
ENG_O2MID_RT_0120.LAB	8/18/2022	8:58:38	54.49	0.046	1.16	-1.72	10.81	**91.1%**	**15**
ENG_O2MID_RT_0121.LAB	8/18/2022	8:58:54	0.25	0.033	0.05	0.23	11.73	**98.8%**	**30**
ENG_O2MID_RT_0122.LAB	8/18/2022	8:59:09	0.27	-0.007	0.00	0.51	11.73	**98.8%**	
ENG_O2MID_RT_0123.LAB	8/18/2022	8:59:24	-0.01	0.035	0.04	-0.35	11.74	**98.9%**	
ENG_O2MID_RT_0124.LAB	8/18/2022	8:59:39	-0.35	0.031	0.00	0.25	11.74	**98.9%**	
ENG_O2MID_RT_0125.LAB	8/18/2022	8:59:54	0.13	0.037	-0.04	0.64	11.73	**98.8%**	
ENG_O2MID_RT_0126.LAB	8/18/2022	9:00:08	-0.20	0.014	0.02	0.07	11.74	**98.9%**	
ENG_O2MID_RT_0127.LAB	8/18/2022	9:00:23	-0.44	0.003	-0.01	0.89	11.74	**98.9%**	
ENG_O2MID_RT_0128.LAB	8/18/2022	9:00:38	-0.21	0.055	0.02	0.62	11.74	**98.9%**	
Average							**11.73**		

N2 System Purge and Response Time Test

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %	Response Time (sec)
ENG_N2_RT_0129.LAB	8/18/2022	9:01:15	-0.57	0.050	0.02	0.67	11.74	**98.9%**	-
ENG_N2_RT_0130.LAB	8/18/2022	9:01:30	0.01	0.048	0.55	-0.80	0.55	**0.1%**	**15**
ENG_N2_RT_0131.LAB	8/18/2022	9:01:45	0.07	0.030	0.02	0.03	0.10	**0.6%**	
ENG_N2_RT_0132.LAB	8/18/2022	9:02:00	-0.26	0.036	-0.01	1.02	0.09	**-2.2%**	
ENG_N2_RT_0133.LAB	8/18/2022	9:02:15	-0.27	0.025	-0.02	0.38	0.09	**-2.3%**	
ENG_N2_RT_0134.LAB	8/18/2022	9:02:30	-0.13	0.023	0.00	0.69	0.08	**-1.1%**	
ENG_N2_RT_0135.LAB	8/18/2022	9:02:45	-0.07	0.042	-0.01	0.06	0.08	**-0.6%**	
ENG_N2_RT_0136.LAB	8/18/2022	9:03:00	-0.38	0.021	0.02	0.65	0.08	**-3.2%**	
ENG_N2_RT_0137.LAB	8/18/2022	9:03:15	0.17	0.001	0.01	0.45	0.08	**1.4%**	
Average							**0.08**		

TR01 Prior to Analyte Spike

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
ENG_0141.LAB	8/18/2022	9:06:35	0.00	0.078	6.70	-2.38	14.83
ENG_0142.LAB	8/18/2022	9:07:35	-0.05	0.073	6.71	-2.37	14.81
ENG_0143.LAB	8/18/2022	9:08:35	0.05	0.083	6.69	-2.08	14.80
Average				**0.078**		**-2.28**	

TR01 Analyte Spike Using 0.598 ppm Formaldehyde / 250.1 ppm N2O

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	Dilution Factor	Formaldehyde Recovery %
ENG_SPK_0152.LAB	8/18/2022	9:13:45	0.10	0.100	6.14	17.38	13.55	**0.082**	**82.4%**
ENG_SPK_0153.LAB	8/18/2022	9:14:00	-0.18	0.128	6.10	17.21	13.60	**0.081**	**105.4%**
ENG_SPK_0154.LAB	8/18/2022	9:14:15	0.61	0.106	6.18	17.21	13.57	**0.081**	**87.3%**
ENG_SPK_0155.LAB	8/18/2022	9:14:30	0.11	0.121	6.13	17.38	13.60	**0.082**	**99.2%**
ENG_SPK_0156.LAB	8/18/2022	9:14:45	-0.24	0.125	6.16	17.29	13.60	**0.081**	**102.9%**
ENG_SPK_0157.LAB	8/18/2022	9:15:00	0.03	0.132	6.18	17.77	13.60	**0.083**	**107.7%**
ENG_SPK_0158.LAB	8/18/2022	9:15:15	0.75	0.102	6.16	17.21	13.61	**0.081**	**84.6%**
ENG_SPK_0159.LAB	8/18/2022	9:15:30	0.30	0.141	6.15	17.28	13.59	**0.081**	**116.5%**
Average				**0.119**		**17.34**		**0.08**	**98.2%**

100.2 ppm Methane System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	Methane Recovery %
ENG_CTS_SYS_0260.LAB	8/18/2022	11:06:47	100.01	-0.071	0.30	-1.65	0.08	**98.2%**
ENG_CTS_SYS_0261.LAB	8/18/2022	11:07:02	99.68	-0.079	0.32	-1.77	0.07	**97.9%**
ENG_CTS_SYS_0262.LAB	8/18/2022	11:07:17	99.90	-0.089	0.31	-1.41	0.07	**98.1%**
ENG_CTS_SYS_0263.LAB	8/18/2022	11:07:32	100.53	-0.114	0.34	-1.73	0.06	**98.7%**
ENG_CTS_SYS_0264.LAB	8/18/2022	11:07:47	100.41	-0.110	0.31	-1.64	0.05	**98.6%**
ENG_CTS_SYS_0265.LAB	8/18/2022	11:08:02	100.22	-0.094	0.30	-1.73	0.03	**98.4%**
ENG_CTS_SYS_0266.LAB	8/18/2022	11:08:17	100.35	-0.123	0.34	-1.80	0.03	**98.6%**
ENG_CTS_SYS_0267.LAB	8/18/2022	11:08:32	100.47	-0.083	0.35	-1.77	0.03	**98.7%**

11.8% O2 System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %
ENG_O2_SYS_0268.LAB	8/18/2022	11:09:34	0.36	0.056	0.02	0.03	11.65	**98.2%**
ENG_O2_SYS_0269.LAB	8/18/2022	11:09:49	0.40	0.016	0.04	0.37	11.65	**98.2%**
ENG_O2_SYS_0270.LAB	8/18/2022	11:10:04	0.38	0.030	0.03	0.88	11.65	**98.2%**
ENG_O2_SYS_0271.LAB	8/18/2022	11:10:19	0.08	0.022	0.00	0.11	11.66	**98.3%**
ENG_O2_SYS_0272.LAB	8/18/2022	11:10:34	0.19	0.031	0.00	0.46	11.66	**98.3%**
ENG_O2_SYS_0273.LAB	8/18/2022	11:10:49	-0.15	0.029	-0.01	0.69	11.66	**98.3%**
ENG_O2_SYS_0274.LAB	8/18/2022	11:11:04	0.64	0.035	-0.05	0.24	11.66	**98.3%**
ENG_O2_SYS_0275.LAB	8/18/2022	11:11:19	0.69	-0.007	0.00	0.79	11.66	**98.3%**
Average							**11.66**	

N2 System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
ENG_N2_SYS_0276.LAB	8/18/2022	11:12:22	-0.43	0.026	0.02	0.42	0.10
ENG_N2_SYS_0277.LAB	8/18/2022	11:12:37	-0.28	0.040	-0.01	-0.05	0.09
ENG_N2_SYS_0278.LAB	8/18/2022	11:12:53	-0.60	0.023	0.03	0.24	0.09
ENG_N2_SYS_0279.LAB	8/18/2022	11:13:07	-0.03	0.020	0.01	0.59	0.08
ENG_N2_SYS_0280.LAB	8/18/2022	11:13:22	-0.19	0.008	0.06	-0.35	0.08
ENG_N2_SYS_0281.LAB	8/18/2022	11:13:37	-0.03	-0.010	-0.02	-0.27	0.08
ENG_N2_SYS_0282.LAB	8/18/2022	11:13:52	0.28	0.029	0.01	0.80	0.08
ENG_N2_SYS_0283.LAB	8/18/2022	11:14:07	0.08	0.004	0.02	0.45	0.08
Average							**0.09**

100.2 ppm Methane System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	Methane Recovery %
ENG_CTS_SYS_0350.LAB	8/18/2022	12:22:32	99.48	-0.079	0.38	-1.66	0.08	**97.7%**
ENG_CTS_SYS_0351.LAB	8/18/2022	12:22:47	99.16	-0.082	0.36	-2.16	0.07	**97.4%**
ENG_CTS_SYS_0352.LAB	8/18/2022	12:23:02	99.50	-0.074	0.34	-1.46	0.06	**97.7%**
ENG_CTS_SYS_0353.LAB	8/18/2022	12:23:17	99.06	-0.079	0.39	-2.13	0.06	**97.3%**
ENG_CTS_SYS_0354.LAB	8/18/2022	12:23:32	99.28	-0.075	0.40	-2.17	0.04	**97.5%**
ENG_CTS_SYS_0355.LAB	8/18/2022	12:23:47	100.48	-0.099	0.38	-1.92	0.03	**98.7%**
ENG_CTS_SYS_0356.LAB	8/18/2022	12:24:02	99.41	-0.106	0.38	-1.74	0.03	**97.6%**
ENG_CTS_SYS_0357.LAB	8/18/2022	12:24:16	99.56	-0.087	0.34	-1.69	0.03	**97.8%**

11.8% O2 System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %
ENG_O2MID_SYS_0364.LAB	8/18/2022	12:27:05	0.27	0.032	-0.01	0.33	11.65	**98.2%**
ENG_O2MID_SYS_0365.LAB	8/18/2022	12:27:20	0.35	0.035	0.02	0.25	11.65	**98.2%**
ENG_O2MID_SYS_0366.LAB	8/18/2022	12:27:35	0.21	0.028	-0.01	0.47	11.66	**98.3%**
ENG_O2MID_SYS_0367.LAB	8/18/2022	12:27:50	0.51	0.026	0.01	0.36	11.65	**98.2%**
ENG_O2MID_SYS_0368.LAB	8/18/2022	12:28:05	0.19	-0.020	0.00	0.62	11.66	**98.3%**
ENG_O2MID_SYS_0369.LAB	8/18/2022	12:28:20	0.51	0.040	-0.03	0.84	11.66	**98.3%**
ENG_O2MID_SYS_0370.LAB	8/18/2022	12:28:35	0.45	-0.011	-0.04	0.59	11.66	**98.3%**
ENG_O2MID_SYS_0371.LAB	8/18/2022	12:28:50	-0.27	0.028	-0.04	0.54	11.66	**98.3%**
Average							**11.66**	

N2 System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
ENG_N2_SYS_0372.LAB	8/18/2022	12:29:42	-0.01	0.028	0.06	0.43	0.10
ENG_N2_SYS_0373.LAB	8/18/2022	12:29:57	-0.60	0.013	0.05	-0.31	0.09
ENG_N2_SYS_0374.LAB	8/18/2022	12:30:11	-0.51	0.037	0.00	-0.31	0.08
ENG_N2_SYS_0375.LAB	8/18/2022	12:30:26	-0.23	0.029	0.02	0.03	0.08
ENG_N2_SYS_0376.LAB	8/18/2022	12:30:41	-0.51	0.011	0.06	-0.24	0.08
ENG_N2_SYS_0377.LAB	8/18/2022	12:30:56	-0.50	0.014	0.04	0.11	0.07
ENG_N2_SYS_0378.LAB	8/18/2022	12:31:11	-0.20	0.024	0.00	0.17	0.07
ENG_N2_SYS_0379.LAB	8/18/2022	12:31:26	0.31	0.025	0.07	0.17	0.07
Average							**0.08**

100.2 ppm Methane System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	Methane Recovery %
ENG_CTS_SYS_0458.LAB	8/18/2022	13:42:48	99.32	-0.093	0.36	-1.35	0.08	**97.5%**
ENG_CTS_SYS_0459.LAB	8/18/2022	13:43:03	99.32	-0.103	0.41	-1.73	0.07	**97.5%**
ENG_CTS_SYS_0460.LAB	8/18/2022	13:43:18	99.85	-0.117	0.35	-1.77	0.06	**98.1%**
ENG_CTS_SYS_0461.LAB	8/18/2022	13:43:33	100.40	-0.101	0.35	-2.05	0.05	**98.6%**
ENG_CTS_SYS_0462.LAB	8/18/2022	13:43:48	100.33	-0.072	0.36	-1.83	0.04	**98.5%**
ENG_CTS_SYS_0463.LAB	8/18/2022	13:44:03	100.43	-0.121	0.42	-2.09	0.03	**98.6%**
ENG_CTS_SYS_0464.LAB	8/18/2022	13:44:18	101.02	-0.063	0.41	-1.79	0.03	**99.2%**
ENG_CTS_SYS_0465.LAB	8/18/2022	13:44:33	101.35	-0.093	0.38	-1.53	0.02	**99.5%**

11.8% O2 System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)	O2 Recovery %
ENG_O2_SYS_0467.LAB	8/18/2022	13:46:00	-0.43	0.015	-0.01	0.06	11.63	**98.0%**
ENG_O2_SYS_0468.LAB	8/18/2022	13:46:15	-0.17	0.006	0.03	-0.25	11.64	**98.1%**
ENG_O2_SYS_0469.LAB	8/18/2022	13:46:30	-0.23	0.026	-0.01	0.17	11.64	**98.1%**
ENG_O2_SYS_0470.LAB	8/18/2022	13:46:45	-0.62	0.011	0.02	-0.23	11.64	**98.1%**
ENG_O2_SYS_0471.LAB	8/18/2022	13:47:00	0.59	-0.002	0.01	0.51	11.64	**98.1%**
ENG_O2_SYS_0472.LAB	8/18/2022	13:47:15	0.01	0.011	-0.04	0.34	11.64	**98.1%**
ENG_O2_SYS_0473.LAB	8/18/2022	13:47:30	-0.06	0.018	0.05	-0.15	11.64	**98.1%**
ENG_O2_SYS_0474.LAB	8/18/2022	13:47:45	-0.25	0.015	0.00	0.11	11.64	**98.1%**
Average							**11.64**	

N2 System Purge

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
ENG_N2_SYS_0478.LAB	8/18/2022	13:50:58	0.06	0.020	0.03	0.47	0.10
ENG_N2_SYS_0479.LAB	8/18/2022	13:51:12	-0.07	0.045	0.00	0.05	0.09
ENG_N2_SYS_0480.LAB	8/18/2022	13:51:27	0.02	0.021	0.05	0.39	0.08
ENG_N2_SYS_0481.LAB	8/18/2022	13:51:42	-0.06	0.033	-0.01	-0.01	0.08
ENG_N2_SYS_0482.LAB	8/18/2022	13:51:57	0.20	0.026	0.02	-0.35	0.08
ENG_N2_SYS_0483.LAB	8/18/2022	13:52:12	-0.39	0.048	0.01	0.17	0.07
ENG_N2_SYS_0484.LAB	8/18/2022	13:52:27	-0.92	0.043	0.02	0.40	0.07
ENG_N2_SYS_0485.LAB	8/18/2022	13:52:42	0.26	0.015	0.04	0.20	0.07
Average							**0.08**

Nitrogen (Zero) Direct Purge to FTIR

Spectrum	Date	Time	Methane (ppmv wet)	Formaldehyde (ppmv wet)	H2O (%v)	Nitrous Oxide (ppmv wet)	O2 (%v wet)
N2_DIR_0487.LAB	8/18/2022	13:57:09	-0.10	0.025	0.02	0.20	0.05
N2_DIR_0488.LAB	8/18/2022	13:59:09	-0.16	0.014	0.01	-0.03	0.05
N2_DIR_0489.LAB	8/18/2022	14:02:14	0.05	0.022	0.01	0.24	0.05

PRISM Analytical Technologies

ANR Pipeline Co, LaGrange, IN
EPA Method 3A Data

8/18/2022	Gas	Cylinder ID	Concentration	Value	Initial Response	Error	OK?
	O_2	UHPN2	Low	0.00	0.04	0.2%	Y
		CC175513	Bias	11.80	11.87	0.3%	Y
		SG9167337BAL	Span	21.80	21.74	0.3%	Y
						≤2%	

System Bias Checks

Run #	Concentration	Certified Value	Analyzer Response	Bias	Drift
Pre Test	Low	0.00	0.08	0.4%	n/a
	Bias	11.80	11.73	-0.3%	n/a
Run 1	Low	0.00	0.09	0.7%	0.5%
	Bias	11.80	11.66	-1.2%	1.5%
Run 2	Low	0.00	0.08	0.7%	0.5%
	Bias	11.80	11.66	-1.2%	1.5%
Run 3	Low	0.00	0.08	0.7%	0.5%
	Bias	11.80	11.64	-1.4%	1.7%
				≤5%	**≤3%**

TR01

Run #1		Run #2		Run #3	
Calculation	**O_2 (%vd)**	**Calculation**	**O_2 (%vd)**	**Calculation**	**O_2 (%vd)**
Average	15.69	**Average**	15.72	**Average**	15.74
Co	0.08	Co	0.08	Co	0.08
Cm	11.70	Cm	11.66	Cm	11.65
Cma	11.80	Cma	11.80	Cma	11.80
Corrected Average:	**15.86**	**Corrected Average:**	**15.95**	**Corrected Average:**	**15.97**

APPENDIX

Certificates of Analysis

Airgas
an Air Liquide company

Airgas Great Lakes region
Airgas USA LLC
1290 Combermere Dr.
Troy, MI 48083
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Customer:	MONTROSE AIR QUALITY SERVICES LLC,		
Part Number:	X02NI99P15A4784	Reference Number:	32-402352595-1
Cylinder Number:	CC22973	Cylinder Volume:	144.3 CF
Laboratory:	112 - Troy-32 (SAP) - MI	Cylinder Pressure:	2015 PSIG
Analysis Date:	Feb 24, 2022	Valve Outlet:	350
Lot Number:	32-402352595-1		

Expiration Date: Feb 24, 2030

Primary Standard Gas Mixtures are traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
METHANE	100.0 PPM	100.2 PPM	+/- 1%
NITROGEN	Balance		

Signature on file

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
6141 Easton Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Customer:	MONTROSE AIR QUALITY SERVICES LLC		
Part Number:	X03NI99C15A02V2	Reference Number:	160-402387941-1
Cylinder Number:	EB0116258	Cylinder Volume:	143.0 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2016 PSIG
Analysis Date:	Apr 28, 2022	Valve Outlet:	350SS
Lot Number:	160-402387941-1		

Expiration Date: Apr 28, 2023

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
FORMALDEHYDE	500.000 PPB	598.181 PPB	+/-5%
NITROUS OXIDE	250.0 PPM	250.1 PPM	+/-2%
NITROGEN	Balance		

Permanent Notes:-NA-

Signature on file
Approved for Release

Cylinder Number:	CC664614	Certification Date:	8/16/2022
Mixture Grade:	EPA Protocol Calibration Gas 1	Issuance Date:	8/16/2022
Certificate Number:	15422C-02T5-C02	Expiration Date:	8/16/2030
Final Pressure:	2200 PSIG	Batch Number:	15422C-02T5
		Part Number:	T5E 4800001-A8-2

Do not use below 100 psi (0.7 megapascals)

EPA Traceability Protocol for Gaseous Calibration Standards Procedure G1, EPA/600/R-12/531 May 2012

Certified Concentrations

Component	Concentration	Analytical Uncertainty		Assay Dates
Carbon Dioxide	10.0 %	0.1 %	Absolute	7/12/2022
Oxygen	11.8 %	0.2 %	Absolute	8/16/2022
Nitrogen	Balance			

Anaytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
Carbon Dioxide	NDIR	Servomex	4100	900033	7/12/2022
Oxygen	GC-TCD	Shimadzu	GC-8A	C10495021497SA	8/8/2022

Reference Standards

Serial Number	Lot	Expiration	Type	Component	Balance	Concentration	Units	Uncertainty	Reference
CC466360	2287A-05T5	1/28/2028	GMIS	CO2	N2	16.17	%	0.156	VSL
CC480398	3308A-05T5	2/19/2028	GMIS	O2	N2	20.91	%	0.113	VSL

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. The nitrogen used as a component or balance gas as well as the oxygen used in air mixtures meets the requirements set forth in 40CFR1065.750. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025-2017.

Carlie Peacock

Analytical Chemist Carlie Peacock

Facility Manager John Schoolcraft

Production Laboratory:
Tier 5 Labs
PGVP Vendor ID R12022
5353 W Southern Ave
Indianapolis, IN 46241

Cylinder Number:	ER0004758		Certification Date:	3/30/2021
Mixture Grade:	EPA Protocol Calibration Gas 1		Issuance Date:	3/31/2021
Certificate Number:	08221C-03T5-C01		Expiration Date:	3/30/2029
Final Pressure:	2015	PSIG	Batch Number:	08221C-03T5
			Part Number:	T5E 4800001-A8-1

Do not use below 100 psi (0.7 megapascals)

EPA Traceability Protocol for Gaseous Calibration Standards Procedure G1, EPA/600/R-12/531 May 2012

Certified Concentrations

Component	Concentration	Analytical Tolerance		Assay Dates
Carbon Dioxide	17.7 %	0.10 %	Absolute	3/30/2021
Oxygen	21.8 %	0.10 %	Absolute	3/30/2021
Nitrogen	Balance			

Anaytical Instrumentation

Component	Analytical Principle	Make	Model	Serial	MPC Date
Carbon Dioxide	GC-TCD	Shimadzu	GC-8A	C10495021497SA	3/23/2021
Oxygen	GC-TCD	Shimadzu	GC-8A	C10495021497SA	3/22/2021

Reference Standards

Serial Number	Lot	Expiration	Type	Component	Balance	Concentration	Units	Uncertainty	Reference
CC462301	1449A-01T5	1/28/2028	GMIS	CO2	N2	17.92	%	0.142	VSL
CC480398	3308A-05T5	2/19/2028	GMIS	O2	N2	20.91	%	0.113	VSL

The calibration results published in this certificate were obtained using equipment and standards capable of producing results that are traceable to National Institute of Standards and Technology (NIST) and through NIST to the International System of Units (SI). The expanded uncertainties, if included on this certificate, use a coverage factor of k=2 to approximate the 95% confidence level of the measurement, unless otherwise noted. If uncertainties are not included on this certificate, they are available upon request. Mixture stability is certified according to maximum certification periods set forth by Table 2-3 of EPA 600/R-12/531 May 2012. The listed expiration date may be extended by special request. The nitrogen used as a component or balance gas as well as the oxygen used in air mixtures meets the requirements set forth in 40CFR1065.750. This calibration certificate applies only to the item described and shall not be reproduced other than in full, without written approval from the calibration facility. Calibration certificates without signatures are not valid. This calibration meets the requirements of ISO/IEC 17025:2017 and ISO/IEC 17034:2016. PJLA accreditation number 76514, PJLA certificate number L20-161.

Carlie Peacock

Analytical Chemist Carlie Peacock

Quality Manager Eric Frymier

Production Laboratory:
Tier 5 Labs
PGVP Vendor ID R12021
5353 W Southern Ave
Indianapolis, IN 46241

B. PROCESS OPERATING DATA

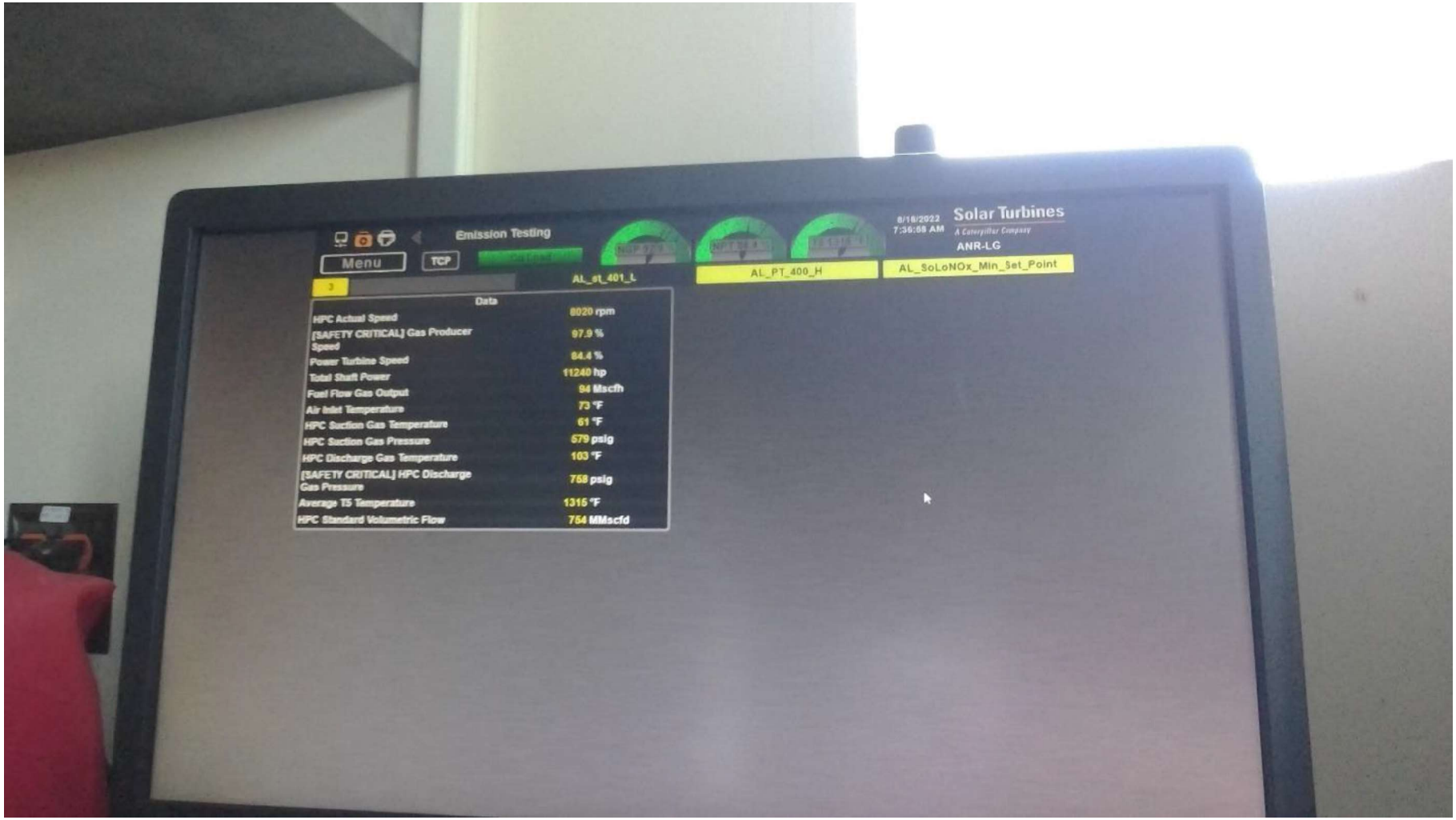
Pipeline	Chromatograph	Date Time	BTU
ANR	LaGrange	08/18/2022 00:00:00	1073.9816

Gravity	Carbon Dioxide	Nitrogen	Methane
0.5996	0.1912	0.3578	91.4731

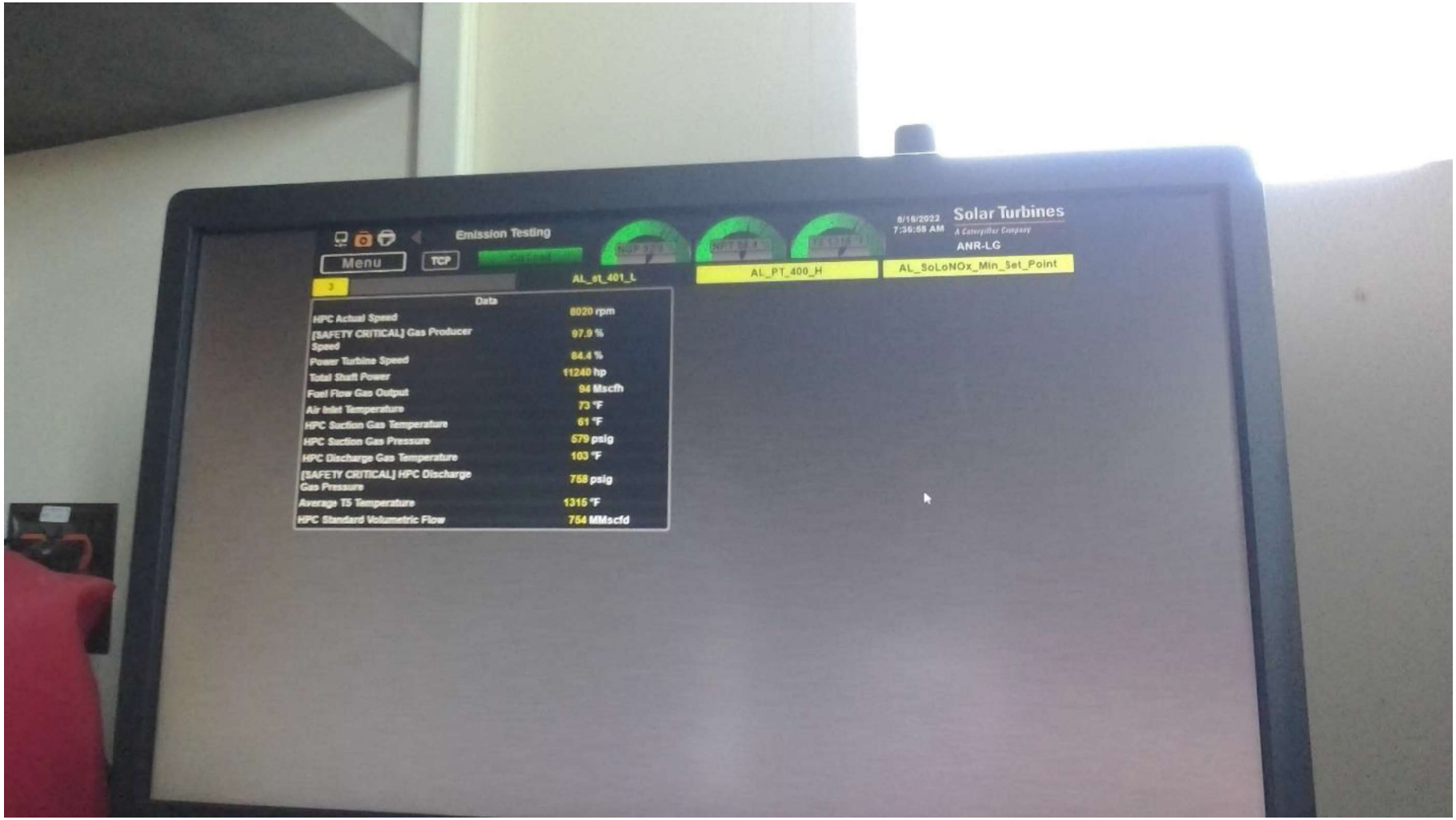
Ethane	Propane	N Butane	Iso Butane
7.5621	0.3358	0.0276	0.0339

Pentane	Iso Pentane	Neo Pentane	Hexane Plus
0.0025	0.0060	0.0000	0.0101

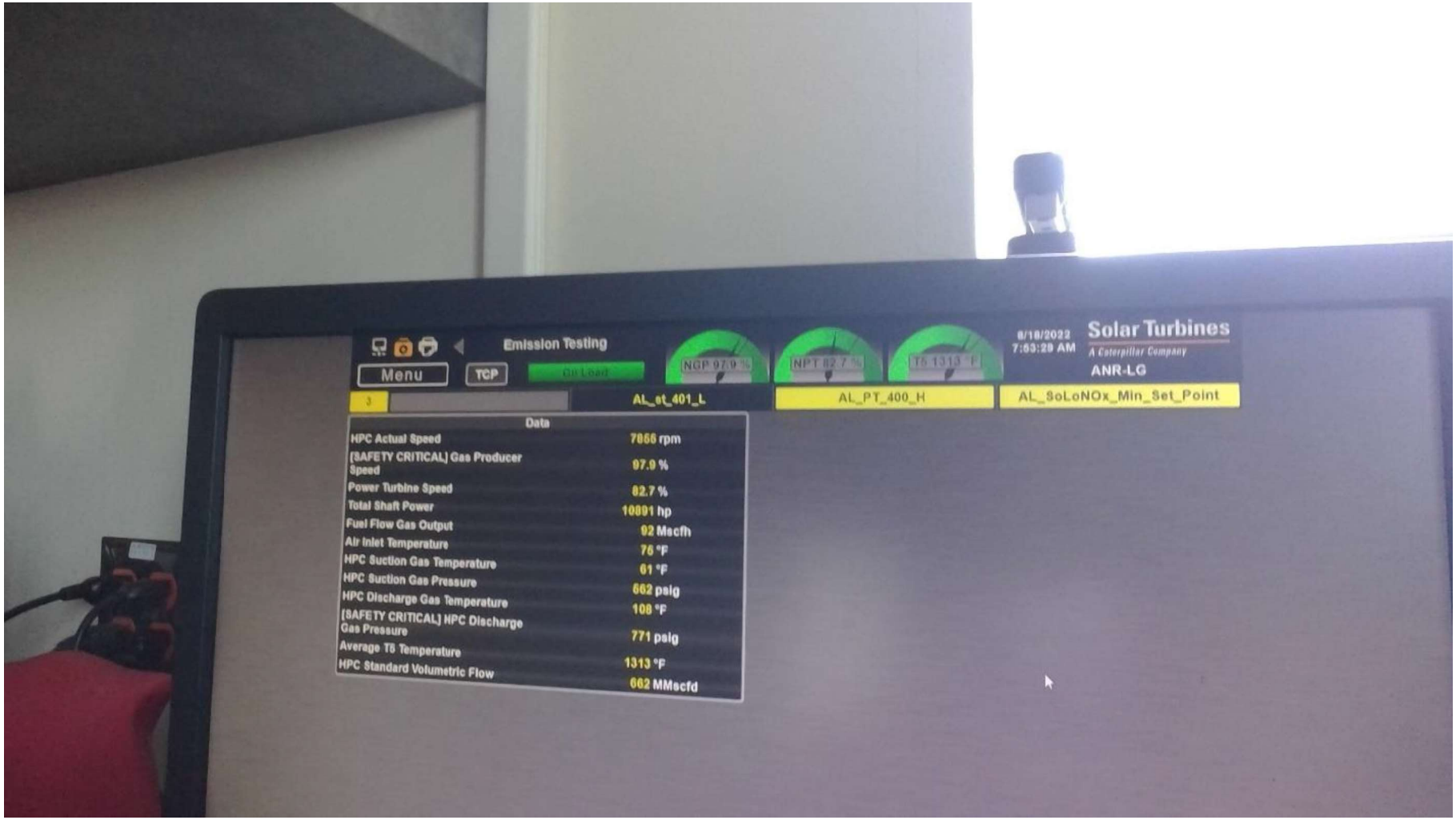
2 hour 45 minute difference between screenshot time and start time



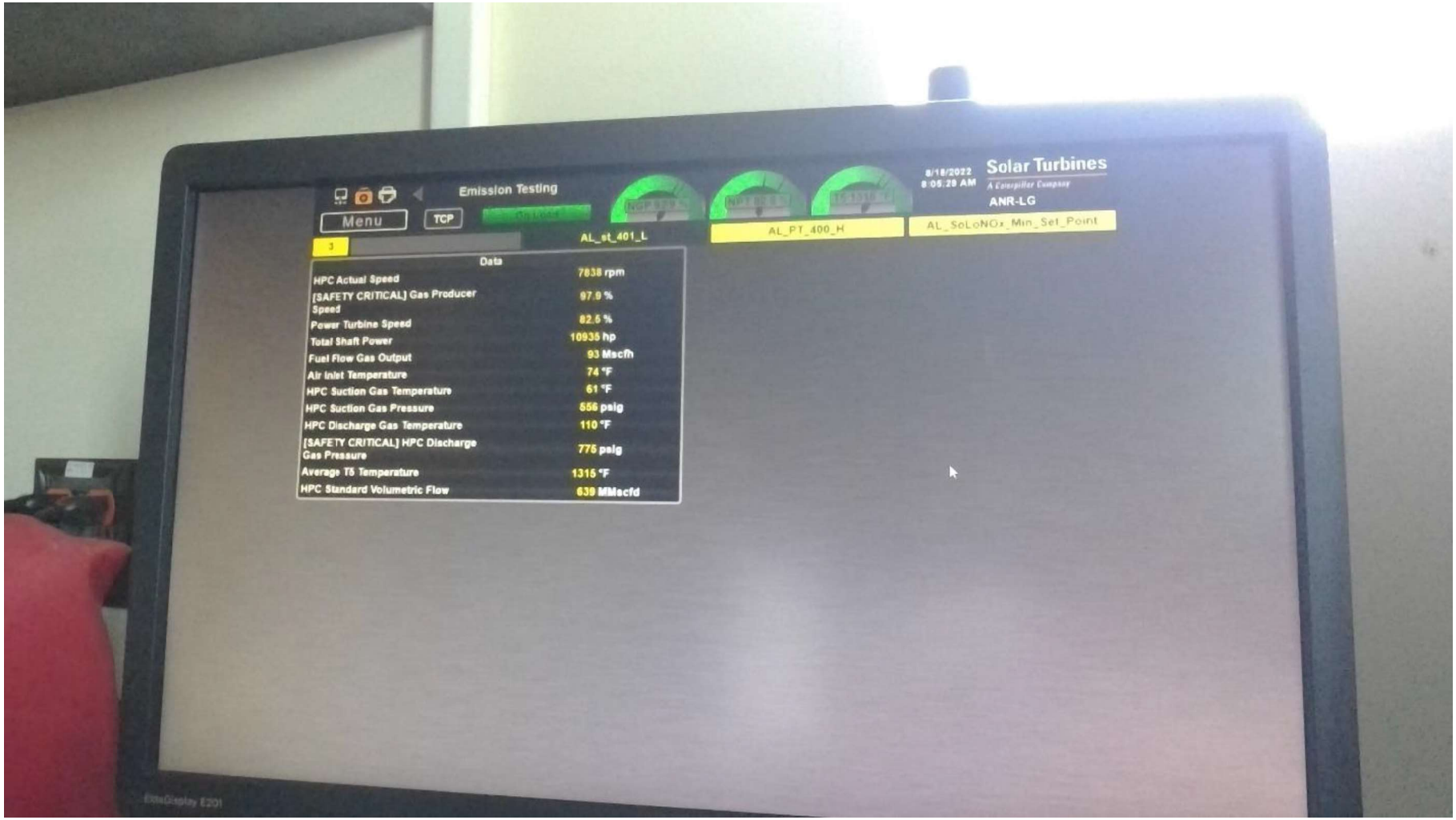
R1 A Baro 14.32 RH 86 Pause 9:58 Resume 10:18


Emission Testing
Menu
TCP
8/16/2022
7:36:58 AM
Solar Turbines
A Caterpillar Company
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 8020 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.9 %
Power Turbine Speed 84.4 %
Total Shaft Power 11240 hp
Fuel Flow Gas Output 94 Mscfh
Air Inlet Temperature 73 °F
HPC Suction Gas Temperature 61 °F
HPC Suction Gas Pressure 579 psig
HPC Discharge Gas Temperature 103 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 768 psig
Average T5 Temperature 1316 °F
HPC Standard Volumetric Flow 764 MMscfd

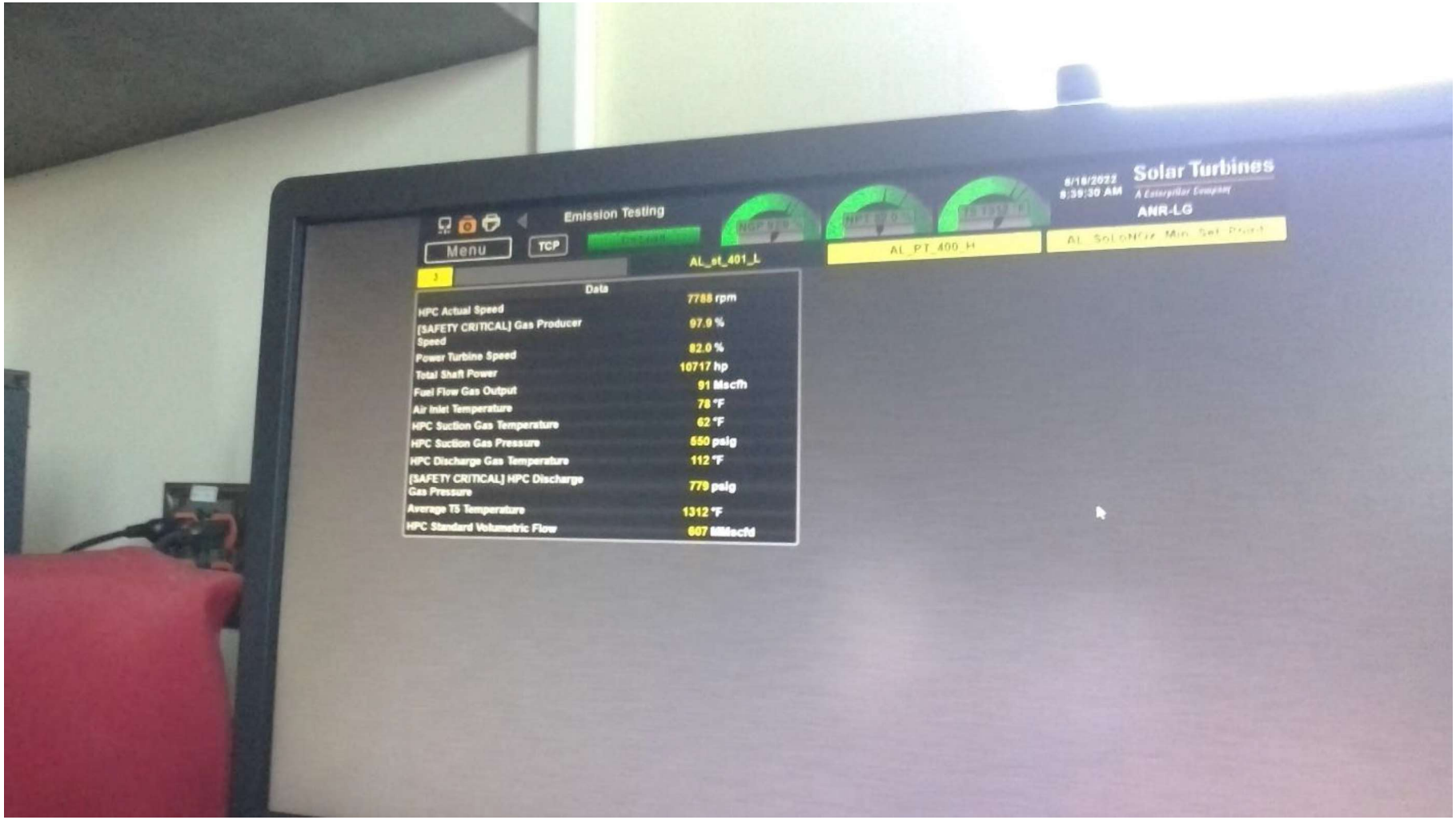
R1 B


Emission Testing
Menu
TCP
8/18/2022
7:53:29 AM
Solar Turbines
A Caterpillar Company
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7866 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.9 %
Power Turbine Speed 82.7 %
Total Shaft Power 10891 hp
Fuel Flow Gas Output 92 Mscfh
Air Inlet Temperature 76 °F
HPC Suction Gas Temperature 61 °F
HPC Suction Gas Pressure 662 psig
HPC Discharge Gas Temperature 108 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 771 psig
Average T8 Temperature 1313 °F
HPC Standard Volumetric Flow 662 MMscfd

R1 C


Emission Testing
Menu
TCP
8/18/2022
8:05:28 AM
Solar Turbines
A Caterpillar Company
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7838 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.9 %
Power Turbine Speed 82.5 %
Total Shaft Power 10935 hp
Fuel Flow Gas Output 93 Mscfh
Air Inlet Temperature 74 °F
HPC Suction Gas Temperature 61 °F
HPC Suction Gas Pressure 556 psig
HPC Discharge Gas Temperature 110 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 775 psig
Average T5 Temperature 1315 °F
HPC Standard Volumetric Flow 639 MMscfd

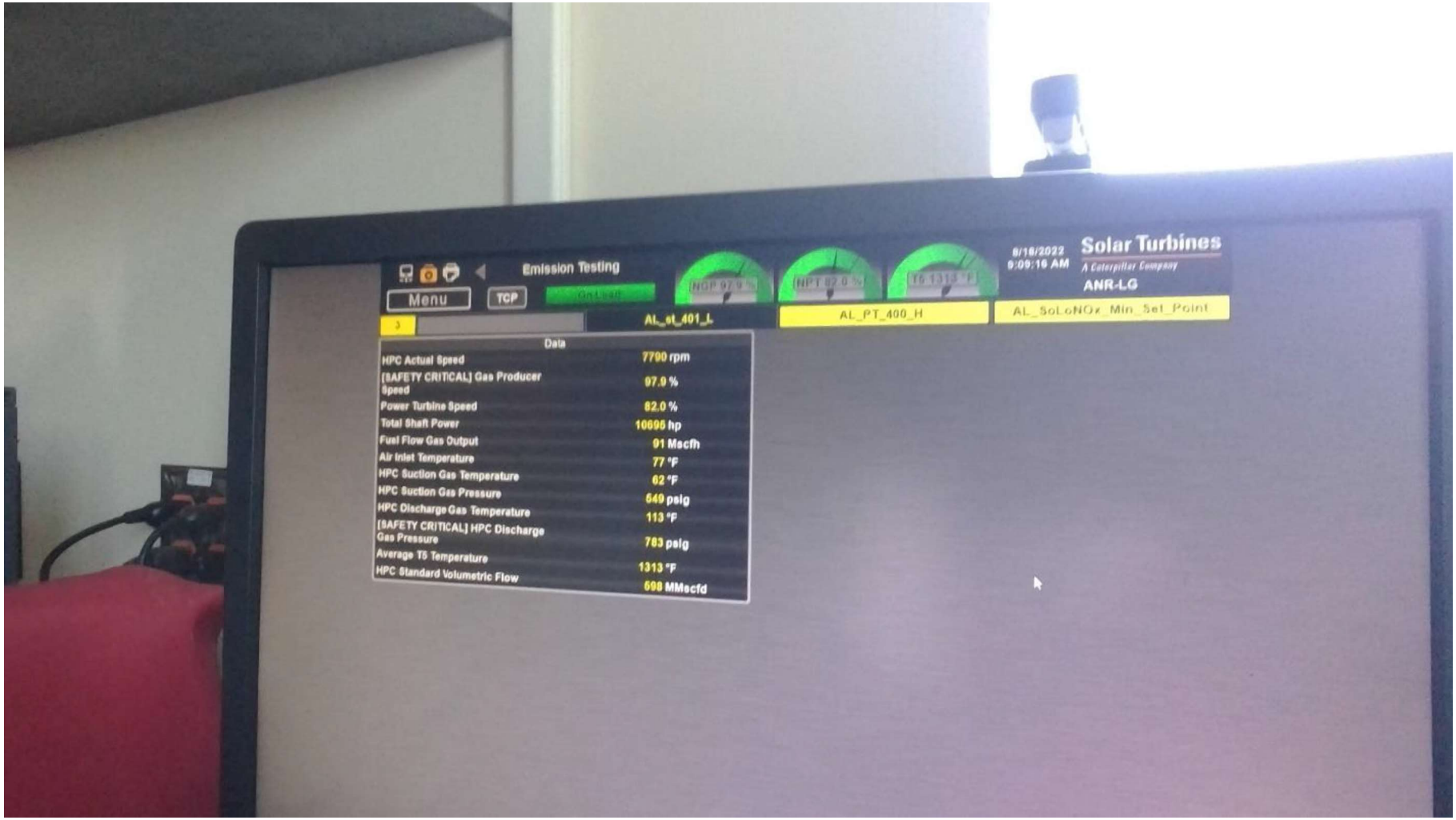
R1 D



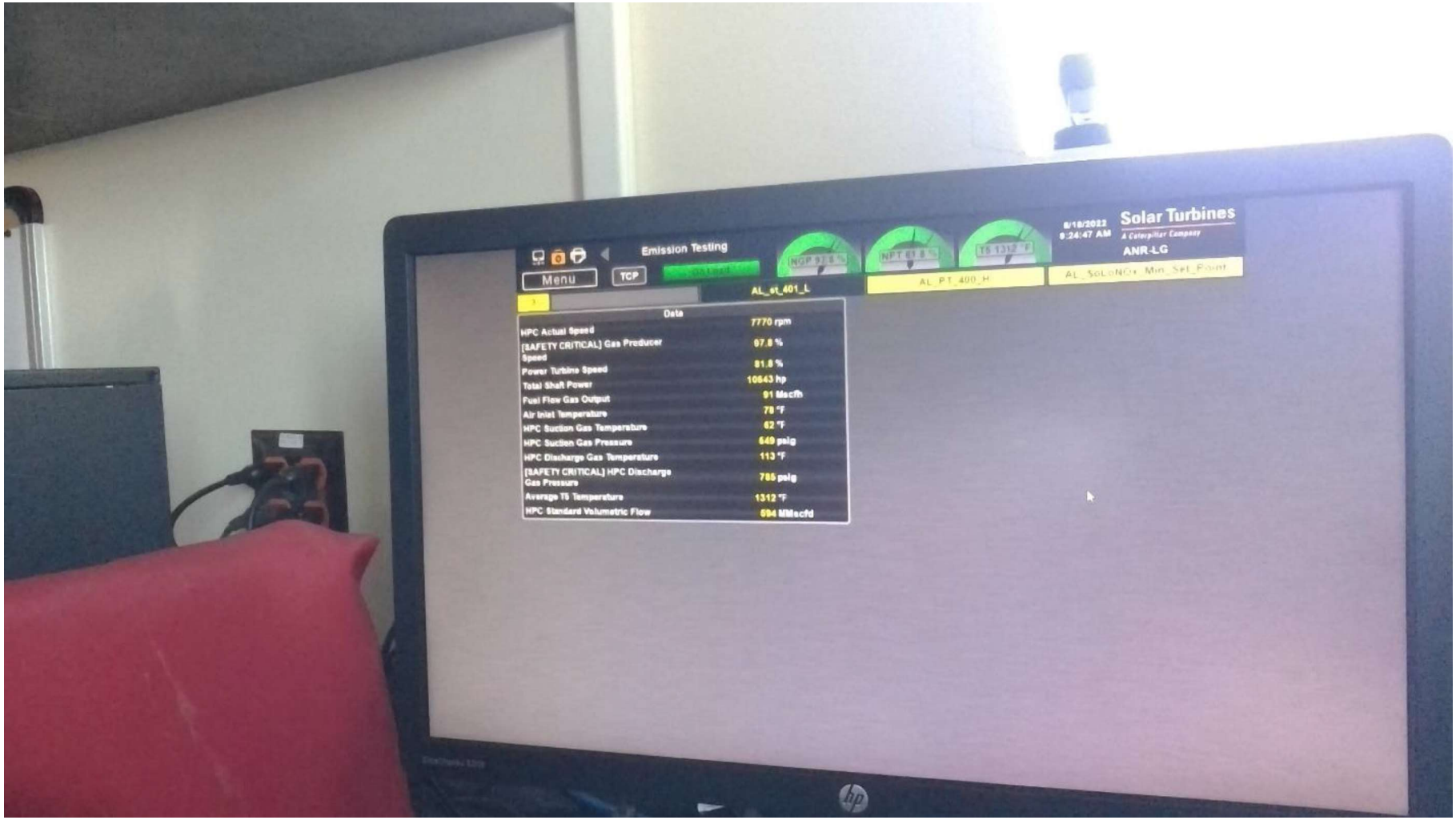
R2 A 14.32 RH 62


Emission Testing
Menu
TCP
Go Load
NGP 97.9 %
NPT 82.0 %
T5 1313 °F
8/18/2022
8:55:14 AM
Solar Turbines
A Caterpillar Company
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7780 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.0 %
Power Turbine Speed 82.0 %
Total Shaft Power 10697 hp
Fuel Flow Gas Output 91 Mscfh
Air Inlet Temperature 77 °F
HPC Suction Gas Temperature 82 °F
HPC Suction Gas Pressure 649 psig
HPC Discharge Gas Temperature 113 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 781 psig
Average T5 Temperature 1313 °F
HPC Standard Volumetric Flow 601 MMscfd

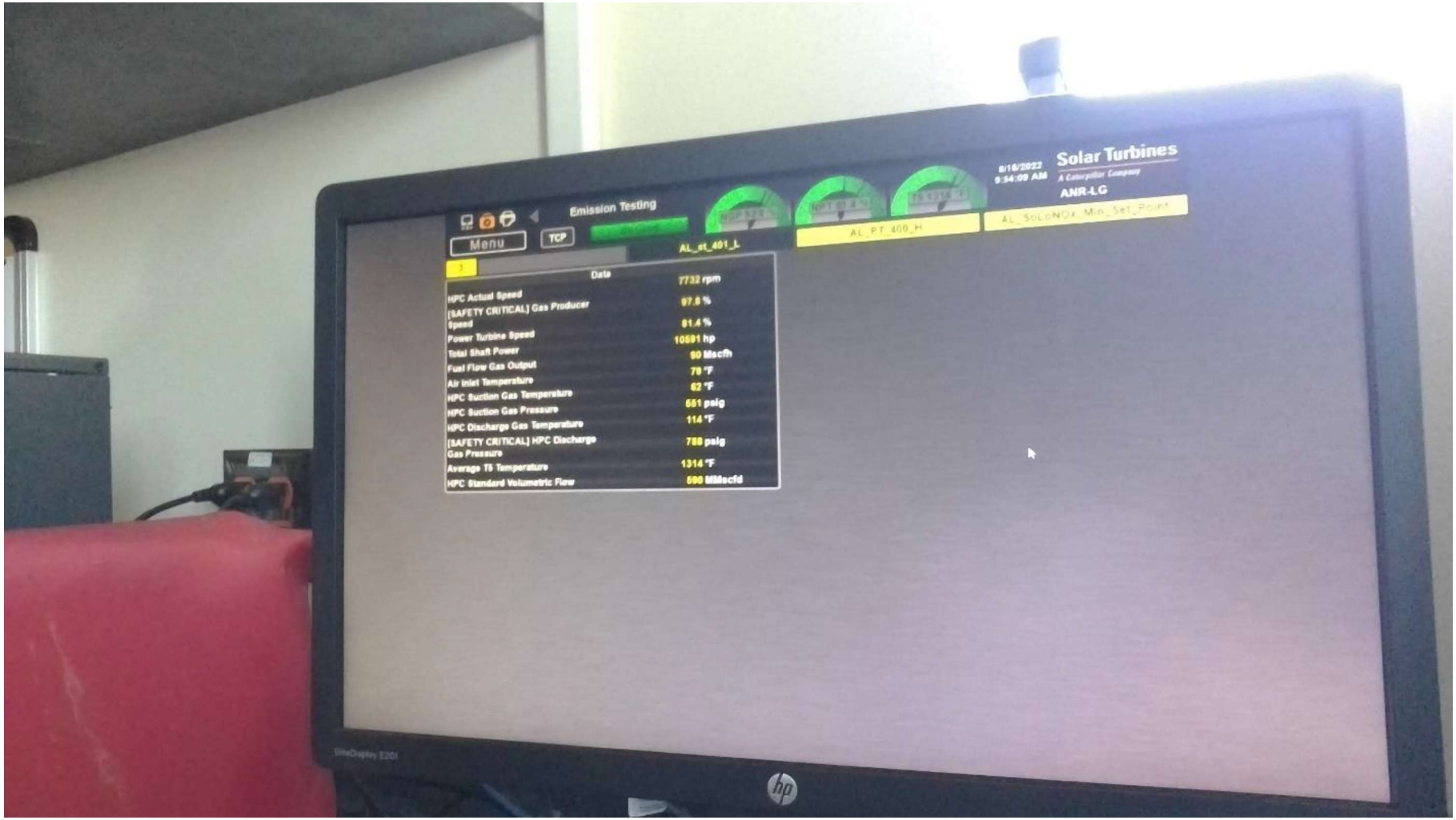
R2 B


Emission Testing
Menu
TCP
8/18/2022
9:09:16 AM
Solar Turbines
A Caterpillar Company
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7790 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.9 %
Power Turbine Speed 82.0 %
Total Shaft Power 10695 hp
Fuel Flow Gas Output 91 Mscfh
Air Inlet Temperature 77 °F
HPC Suction Gas Temperature 62 °F
HPC Suction Gas Pressure 649 psig
HPC Discharge Gas Temperature 113 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 783 psig
Average T5 Temperature 1313 °F
HPC Standard Volumetric Flow 598 MMscfd

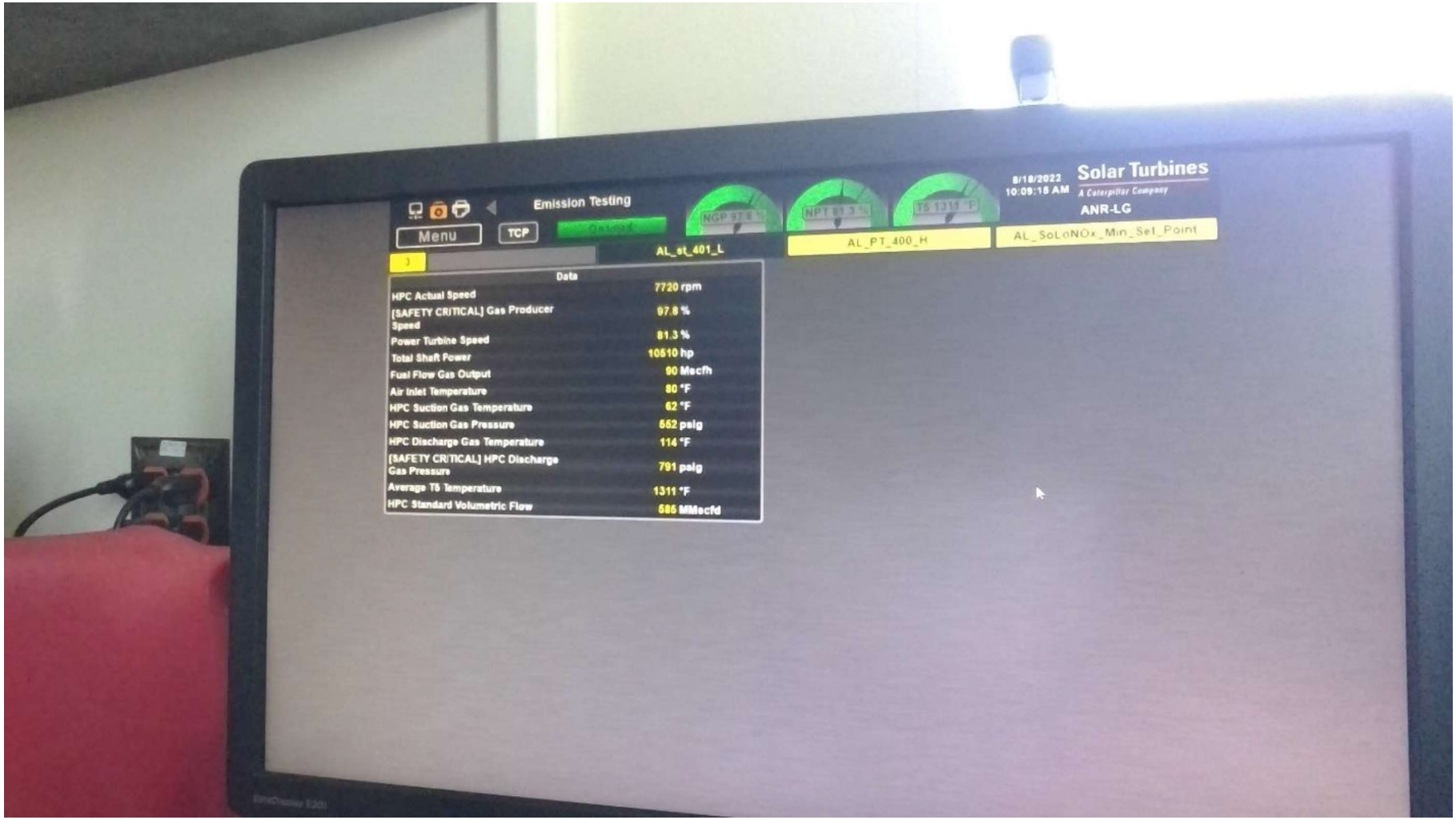
R2 C


Emission Testing
Menu
TCP
AL_st_401_L
AL_PT_400_H
Solar Turbines
A Caterpillar Company
ANR-LG
Data
HPC Actual Speed 7770 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.8 %
Power Turbine Speed 81.8 %
Total Shaft Power 10643 hp
Fuel Flow Gas Output 91 lbm/h
Air Inlet Temperature 79 °F
HPC Suction Gas Temperature 62 °F
HPC Suction Gas Pressure 649 psig
HPC Discharge Gas Temperature 113 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 785 psig
Average T5 Temperature 1312 °F
HPC Standard Volumetric Flow 594 MMscfd

R2 D



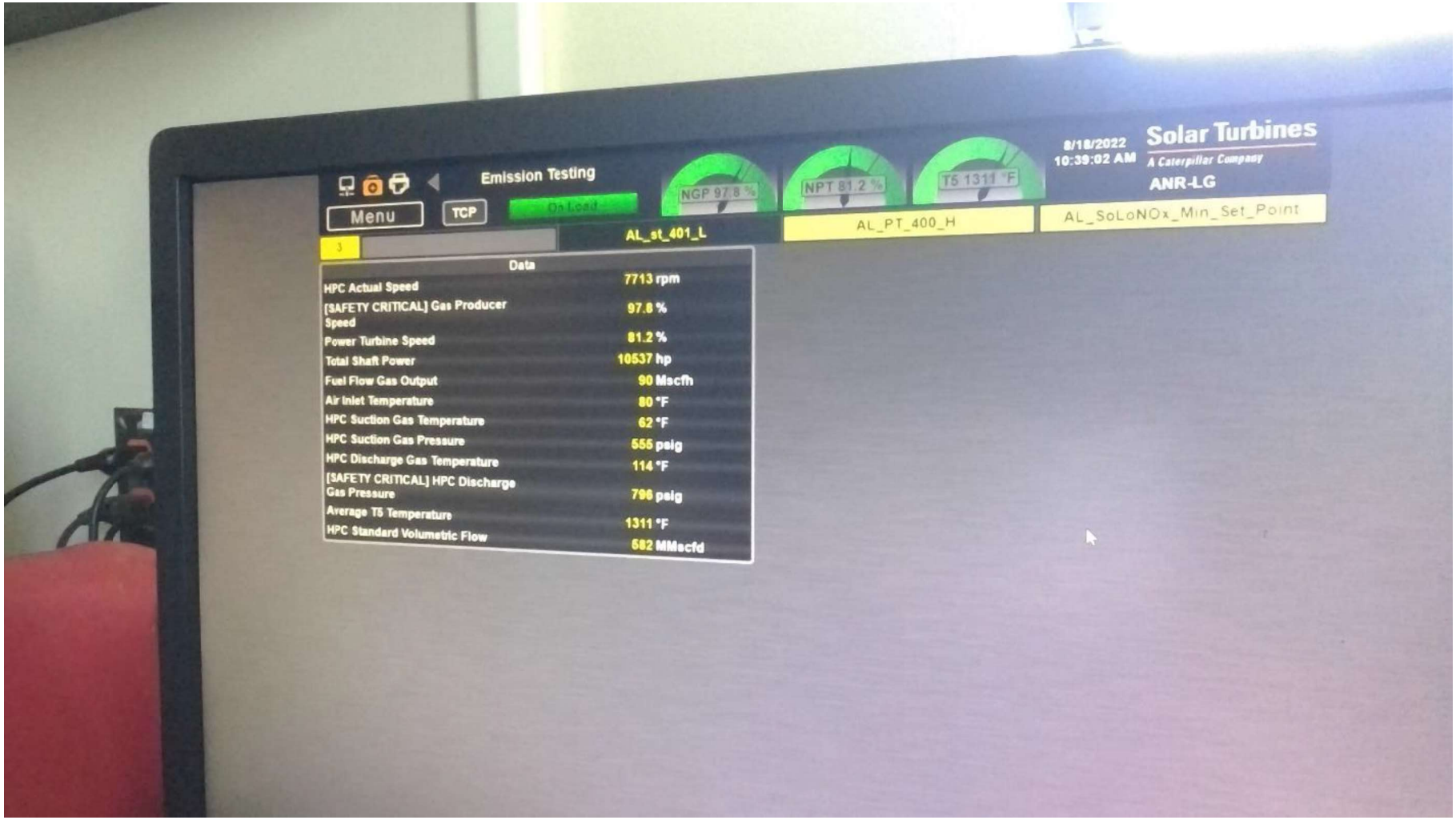
R3 A Baro 14.32 RH 54


Emission Testing
Menu
TCP
Solar Turbines
A Caterpillar Company
8/18/2022
10:09:18 AM
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7720 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.8 %
Power Turbine Speed 81.3 %
Total Shaft Power 10610 hp
Fuel Flow Gas Output 90 Mscfh
Air Inlet Temperature 80 °F
HPC Suction Gas Temperature 62 °F
HPC Suction Gas Pressure 562 psig
HPC Discharge Gas Temperature 114 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 791 psig
Average T5 Temperature 1311 °F
HPC Standard Volumetric Flow 586 MMscfd

R3 B


Emission Testing
Menu
TCP
Solar Turbines
A Caterpillar Company
ANR-LG
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7703 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.8 %
Power Turbine Speed 81.1 %
Total Shaft Power 10471 hp
Fuel Flow Gas Output 89 Mscfh
Air Inlet Temperature 80 °F
HPC Suction Gas Temperature 62 °F
HPC Suction Gas Pressure 553 psig
HPC Discharge Gas Temperature 114 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 794 psig
Average T5 Temperature 1311 °F
HPC Standard Volumetric Flow 582 MMscfd

R3 C


Emission Testing
Menu
TCP
On Load
NGP 97.8 %
NPT 81.2 %
T5 1311 °F
8/18/2022
10:39:02 AM
Solar Turbines
A Caterpillar Company
ANR-LG
AL_st_401_L
AL_PT_400_H
AL_SoLoNOx_Min_Set_Point
Data
HPC Actual Speed 7713 rpm
[SAFETY CRITICAL] Gas Producer Speed 97.8 %
Power Turbine Speed 81.2 %
Total Shaft Power 10537 hp
Fuel Flow Gas Output 90 Mscfh
Air Inlet Temperature 80 °F
HPC Suction Gas Temperature 62 °F
HPC Suction Gas Pressure 555 psig
HPC Discharge Gas Temperature 114 °F
[SAFETY CRITICAL] HPC Discharge Gas Pressure 796 psig
Average T5 Temperature 1311 °F
HPC Standard Volumetric Flow 582 MMscfd

R3 D

C. SAMPLE CALCULATIONS

H_2CO Gaseous Emissions Example Calculations

Client	TC Energy Lagrange	Run	2	Test Time	11:20-12:20		
Unit	TR01	Test Date	8/18/2022				
Load	100%						
Sample Train Data							
				MW_s=	28.01 for CO		
Reference Temperature, °R		528	T_{ref}= (°F plus 460)		46.01 fo NOx	Reported	0.074
Concentraion of gaseous species, ppmvd		0.069	C		64.06 for SOx	Example	0.074
Molecular weight of gaseous species, lb/lb mole		30.026	MW_s		30.026 H_2CO	% Difference	-0.57
Stack O_2 % dry		15.43	O_2				
Grams in a pound		453.592					
Specific molar volume of an ideal gas at standard conditions, ft^3/lb mole		385.3	SV				

Gaseous Emissions

a. Concentration, ppm @ 15% O2 dry

$$C_3 = (C)\left[\frac{(20.9 - 15.0)}{(20.9 - \%O_2)}\right]$$

$$C_3 = 0.069\left[\frac{(20.9 - 15.0)}{5.47}\right]$$

C_3 = **0.074** ppm @ 15% O2

D. CORRESPONDENCE

EMISSION TEST PLAN DOCUMENTATION

Frasure, Anova

From: Frasure, Anova
Sent: Wednesday, June 15, 2022 9:47 AM
To: IDEM Test Protocol
Cc: r5airenforcement@epa.gov
Subject: ANR Pipeline Lagrange CS Test Plan-August 18, 2022
Attachments: Lagrange TR01 test plan 6 11 22.pdf; Lagrange TR01 protocol 5 25 2022 for report.pdf

Mr. Cline,

On behalf of our client, TC Energy, ANR Pipeline, we are submitting the attached compliance test plan and protocol as required by conditions of permit 087-42922-0004. The Air Compliance Team of TC Energy contracted EQM to test the Unit TR01 Turbine at the Lagrange Compressor Station. The testing will be performed in accordance with the requirements of the Code of Federal Regulations, Title 40, Part 60, Subpart A. The testing on the turbine is being tested to comply with regulatory requirement 40 CFR 63, YYYY and will be consistent with USEPA Methods 320 outlined in the attached test plan. Testing is scheduled for August 18, 2022.

TC Energy (ANR) respectfully requests approval of this test date and plan. If you have questions or require additional information, please feel free to contact me via telephone at (219) 661-9900 or email kmast@eqm.com. Additional contact information may be found in the test plan.

Anova Frasure | Office Manager
Main: 219.661.9900 | afrasure@eqm.com
1280 Arrowhead Ct., Suite 2 | Crown Point, IN 46307
www.eqm.com
Email is the best way to communicate to receive immediate assistance.

Frasure, Anova

From: IDEM Test Protocol <Test_Protocol@idem.IN.gov>
Sent: Wednesday, June 15, 2022 9:51 AM
To: Frasure, Anova
Subject: Automatic Reply: ANR Pipeline Lagrange CS Test Plan-August 18, 2022

Importance: Low

Thank you! Your submittal has been received.

As of 6/23/22, there has been no response from EPA R5

Frasure, Anova

From: Frasure, Anova
Sent: Friday, June 17, 2022 9:19 AM
To: 'r5airenforcement@epa.gov'
Subject: RE: ANR Pipeline Lagrange CS Test Plan-August 18, 2022

Air Compliance Test Scheduling,

I'm just reaching out to make sure you received the below email and the one for Sulphur Springs that was sent out on Wednesday, June 15, 2022. I usually get a reply back via email, and I have not yet.

Thanks,

Anova Frasure | Office Manager | 219.661.9900 | afrasure@eqm.com

---

From: Frasure, Anova
Sent: Wednesday, June 15, 2022 9:47 AM
To: IDEM Test Protocol <Test_Protocol@idem.IN.gov>
Cc: r5airenforcement@epa.gov
Subject: ANR Pipeline Lagrange CS Test Plan-August 18, 2022

Mr. Cline,

On behalf of our client, TC Energy, ANR Pipeline, we are submitting the attached compliance test plan and protocol as required by conditions of permit 087-42922-0004. The Air Compliance Team of TC Energy contracted EQM to test the Unit TR01 Turbine at the Lagrange Compressor Station. The testing will be performed in accordance with the requirements of the Code of Federal Regulations, Title 40, Part 60, Subpart A. The testing on the turbine is being tested to comply with regulatory requirement 40 CFR 63, YYYY and will be consistent with USEPA Methods 320 outlined in the attached test plan. Testing is scheduled for August 18, 2022.

TC Energy (ANR) respectfully requests approval of this test date and plan. If you have questions or require additional information, please feel free to contact me via telephone at (219) 661-9900 or email kmast@eqm.com. Additional contact information may be found in the test plan.

Anova Frasure | Office Manager
Main: 219.661.9900 | afrasure@eqm.com
1280 Arrowhead Ct., Suite 2 | Crown Point, IN 46307
www.eqm.com
Email is the best way to communicate to receive immediate assistance.

1. Introduction

1.1. The Air Compliance Team of TC Energy's ANR Pipeline Company has scheduled a source emissions testing event at the ANR Lagrange Compressor Station for **August 18, 2022** in fulfillment of Indiana Department of Environmental Management (IDEM), permit no. 087-42922-00004. The Turbine TR01 is subject to 40 CFR Part 63, Subpart YYYY requirement. As such, the following parameter will be determined:

1.1.1. Turbine TR01 with an emission limit of **≤91 ppbvd@15%O2 Formaldehyde**

1.2. Facility Information

1.2.1. Facility Location

ANR Pipeline Lagrange Compressor Station
2255 West U.S. 20
Lagrange, IN 46761

1.2.2. Testing Coordinator

Pedro Amieva
700 Louisiana Street, Suite 700
Houston, TX 77002
(832) 320-5839
Email: Pedro_Amieva@tcenergy.com

1.2.3 Testing Firm

Environmental Quality Management, Inc.
1280 Arrowhead Ct. Ste. 2
Crown Point, IN 46307
Karl Mast, Manager, Emission Management
(219) 776-6056 Cell
kmast@eqm.com
Zach Hill, Field Activity Lead
(219) 798-5468
zhill@eqm.com

2. Process Description

Unit TR01 is a natural gas fired Mars 90 stationary gas turbine, with ISO rating of 13,220 hp (9.86 MW), using SoLoNOx (lean/premix) as control, exhausts to Stack S03.

Sampling Ports & Traverse Point Locations will be determined on site.

3. Testing Instrumentation and Sampling System

3.1. TC Energy has contracted the services of EQM Inc. (please consult the contractor's web site for further information at http://www.eqm.com) to perform the test. EQM Inc. personnel will utilize an emission test platform (ETP) to perform the test.

3.2. Exhaust gas enters the system through a stainless-steel probe connected to a sintered filter. The sample is transported via a Teflon sample line through, and into a minimum contact condenser specially designed to dry the sample into a stainless-steel sample pump. The sample is then passed through 3/8" Teflon tubing to the sample manifold. The sample manifold is maintained at a constant pressure by means of an ambient bypass. The stainless-steel internal pumps control the sample flow to O2 analyzer. The flow schematic can be viewed in the attachment.

3.3. Formaldehyde emissions will be measured using USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy". Gaseous samples will be withdrawn from the stack and transferred to the FTIR spectrometer.

3.4. An MKS MultiGas 2030 FTIR spectrometer configured with a StarBoost system will be used. The StarBoost technology consists of a 5-micron infrared detector, optical filtration and signal amplification. It is designed to optimize signal response and limit instrument noise for low detection limit applications. The FTIR is equipped with a temperature-controlled, 5.11-meter multipass gas cell maintained at 191°C.

4. General Testing Procedure

4.1. Formaldehyde emissions will be measured using USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy". All data will be collected in differential mode with 2 cm-1 resolution sample data and 8 cm-1 resolution background. Each FTIR spectrum will be derived from the coaddition of 200 scans, with a new data point generated approximately every 60 seconds.

4.1.1. The 0.5 ppm formaldehyde standard for analyte spiking, with 250 ppm N2O tracer gas. Methane will be used as the CTS.

4.2. EPA Protocol Gases: EPA protocol 1 calibration gases will be used for analyzer

calibrations. Certification sheets will be available at the test site.

4.2.1. The range of paramagnetic O_2 analyzer will be 0-25%.

4.3. Determine of Stratification: Three points on a line passing through the centroidal area will be used, spaced at 16.7, 50.0, and 83.3 percent of the measurement line. The sampling time will be twice the system response time at each traverse point.

4.4. Measurement system Preparation: Each analyzer will be set up to the correct response and those responses will be recorded by the data acquisition system. The calibration curve will be then established to convert each analyzer's response to equivalent gas concentrations as introduced to each analyzer. The sample flow rate will remain the same throughout the entire test.

4.5. Calibration Error Check: Zero, mid, and high calibration gas will be introduced, without adjustment, to the analyzers and their responses recorded. The response will be considered acceptable if they are within +/- 2 percent of the calibration span.

4.6. Sample Line Leak Check: The sample line will be leak checked before the testing by closing the calibration valve assembly while the sample pump is operating. Once the maximum vacuum is reach, the rotameter ball will fall to the bottom. The leak check will be considered acceptable if the ball comes to rest at the bottom of the gas column.

4.7. System Bias Check: An upscale gas will first introduce to the analyzer in the direct calibration mode. The analyzer will be allowed to stabilize, and the reading is noted. The same gas will then be introduced at the sample probe, passing through the entire sample system to the analyzer, and the reading noted. The resultant readings will indicate any bias attributed to the sample system. This process will be repeated with the analyzer's zero gas.

4.8. The bias check will be considered acceptable if the direct gas reading of the analyzer is within +/- 5 percent of the complete sample train reading of the analyzer. The same procedure will also be conducted for the O_2 analyzer.

4.9. Drift Check: Bias checks before and after will be used to determine a zero and upscale drift for NO_x and O_2 analyzers. The drift check will be considered acceptable if the zero and the upscale drift for each test run period less than +/- 3 percent of the calibration values.

4.10. Response Time Check: Zero gas will be introduced into the sample system at the outlet of the probe until all readings are stable. The calibration valve will then be switched to sample the upscale gas at the outlet of the probe until a stable reading is obtained, within 5 percent of the certified value of the upscale gas. The upscale response time will be recorded. Next, the zero gas will be introduced in the same manner as the upscale gas. Once a stable reading is noted, within 5 percent of the certified value of the upscale gas, the downscale response time will be recorded. The longer interval is the response time.

4.11. Interference Response if required: Vendor instrument data concerning interference in the analyzer will be included in the test report Appendices.

4.12. Formaldehyde emissions will be measured using USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy". Gaseous samples will be withdrawn from the stack and transferred to the FTIR spectrometer. The samples will be directed through a heated probe, heated filter, and heated transfer line connected to the FTIR. The probes, filters, transfer lines, and FTIR will be maintained at approximately 150° C (376° F) during the testing. Concentrations will be measured based on their infrared absorbance compared to reference spectra. The FTIR analyzer scans the sample approximately once per second. A data point consists of the additions of 64 scans, with a data point generated every minute.

4.12.1. FTIR quality assurance procedures will be followed for USEPA Method 320. A calibration transfer standard (CTS) will be analyzed before and after testing. Acetaldehyde spiking will be performed before and after the test. Section 3.29 of the USEPA Method 320 allows the use of a surrogate analyte of spiking. Acetaldehyde may be chosen as a surrogate to formaldehyde for the following reasons.

5. Emissions Testing

5.1. Sample Location: The sampling point in the exhaust stack will be at least two stack diameters downstream and at least one-half diameters upstream from any flow disturbance as per 40CFR60 Method 1.

5.2. All Method 320 data will be collected in differential mode with 2 cm-1 resolution sample data and 8 cm-1 resolution background. Each FTIR spectrum will be derived from the coaddition of 200 scans, with a new data point generated approximately every 60 seconds. Formaldehyde emissions will be measured using USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy". Gaseous samples will be withdrawn from the stack and transferred to the FTIR spectrometer.

5.3. Sample Location: A single point probe consisting of 3/8-inch stainless steel tubing open at one end will be used to collect the samples if the concentration at each traverse point is within 5 % of the mean concentration; three points will be used if concentration at each traverse point is within 5 to 10% of the mean concentrations. The concentration is considered stratified if the 10% criterion is not met; therefore, twelve traverse points will be used. The sampling point in the exhaust stack will be at least two stack diameters downstream and at least one-half diameters upstream from any flow disturbance as per 40CFR60 Method 1.

5.4. Fuel Gas Analysis: A fuel gas sample will be taken during the testing. The sample will be analyzed by the pipeline gas chromatograph. This analysis will give the actual specific gravity, BTU, and mole percentages of fuel gas species (through C6+) so that fuel flow, and mass emissions can be accurately calculated.

5.5. Compliance Test Runs: EPA Reference methods, as described in 40 CFR, Part 60, Appendix A, will be followed to conduct this testing. Dilution concentration of exhaust oxygen will be determined by Method 3A. The exhaust gases will be sampled continuously to determine O_2 and Formaldehyde (H2CO) concentrations for three 60-minutes test runs at 100% +/-10% for TR01. Moisture will be determined by method 320.

5.6. The engine exhaust can vary substantially depending upon air-fuel ratio, load and stack geometric considerations, but will generally be at 800-1100 °F, 8-12 % moisture and <100fps stack velocity.

5.7. All data will be processed on site and no sample transfer of custody will be required. No CEMS data exists and this is not applicable to these sources. Process conditions during the test will be adjusted to achieve the maximum horsepower possible, up to the engine rating. Process conditions to be monitored and collected during the test will include horsepower, fuel consumption, suction and discharge pressures, heat rates and ambient conditions among others.

6. Test Results

6.1. A copy of the compliance test report will be submitted to the IDEM, Air Quality Division, within 45 days of completion of the test program. The test report will follow the general outline of this test protocol. Data summaries, raw data, calibration sheets, gas analysis, operating parameters and other relevant information will be contained in the test report Appendices.

7. Calculations

7.1. Calibration Correction

$$C_{GAS} = (C_R - C_O)\frac{C_{MA}}{C_M - C_O}$$

Where:

C_{GAS}: Corrected flue gas concentration (ppmvd)

C_R: Flue gas concentration (ppmvd)

C_O: Average of initial and final zero checks (ppmvd)

C_M: Average of initial and final span checks (ppmvd)

C_{MA}: Actual concentration of span gas (ppmvd)

7.2. EPA F-Factor

$$F_d = \frac{\left[\left(3.64 \cdot H_{Wt\%} \cdot 100\right) + \left(1.53 \cdot C_{Wt\%} \cdot 100\right)\right]}{\frac{GCV}{\rho_{FuelGas}}} \cdot 10^6 + \frac{\left[\left(0.14 \cdot N_{2Wt\%} \cdot 100\right) - \left(0.46 \cdot O_{2Wt\%} \cdot 100\right)\right]}{\frac{GCV}{\rho_{FuelGas}}} \cdot 10^6$$

Where:

F_d: Fuel specific F-factor, dscf/MMBtu
$H_{Wt\%}$: Hydrogen weight percent
$C_{Wt\%}$: Carbon weight percent
$N_{2Wt\%}$: Nitrogen weight percent
$O_{2Wt\%}$: Oxygen weight percent
GCV: Heating value of the fuel, BTU/dscf
$\rho_{Fuel\ Gas}$: Density of the fuel gas, lb/scf

Where:

C_d: Pollutant concentration, lb/scf
F_d: Fuel specific F-factor, dscf/MMBtu
Q_h: Fuel flow, scf/hr
$\%O_2$: Oxygen concentration in percent, measured on a dry basis
GCV: Upper dry heating value of fuel, Btu/dscf

7.3. Inlet Analyzer Drift Correction

$$Cgas = (CAve - CO)\left(\frac{Cma}{Cm-Co}\right)$$

Where:

C_{GAS}: Average effluent gas concentration adjusted for bias
C_{Ave}: Average unadjusted gas concentration indicated by data recorder for the test run
C_O: Average of initial and final zero checks
C_M: Actual concentration of the upscale calibration gas
C_{MA}: Average of initial and final system calibration bias check responses for the upscale calibration gas

7.4. Outlet Analyzer Drift Correction

$$Cgas = (CAve - CO)\left(\frac{Cma}{Cm-Co}\right)$$

Where:

C_{GAS}: Average effluent gas concentration adjusted for bias
C_{Ave}: Average unadjusted gas concentration indicated by data recorder for the test run
C_O: Average of initial and final zero checks (ppmvd)
C_M: Actual concentration of the upscale calibration gas
C_{MA}: Average of initial and final system calibration bian check responses for the upscale calibration gas

Figure 1. USEPA Method 3A Sampling Train

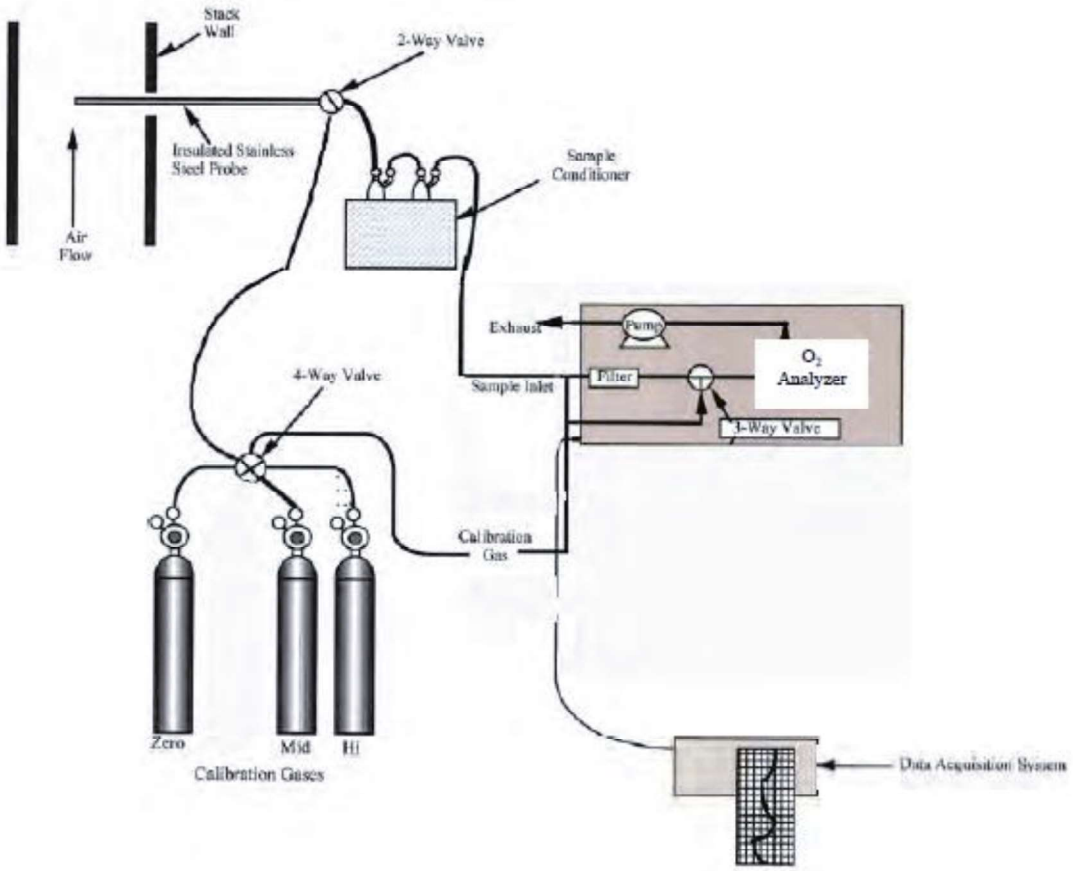


Figure 2. USEPA Method 320 Sampling Train

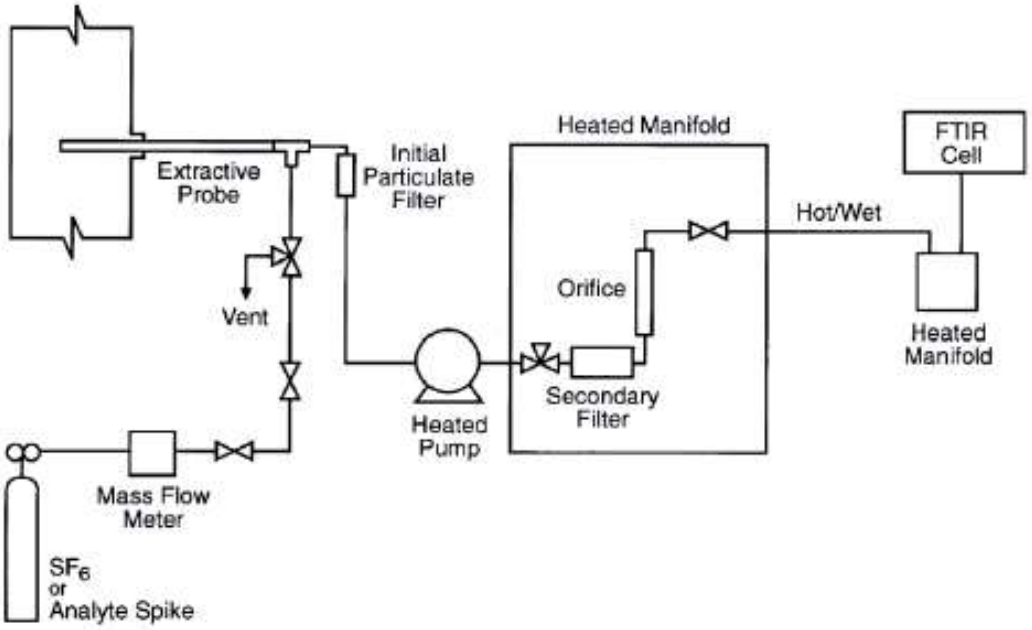


Table 1.. USEPA Method 320 System Checks

QAQC Specification	Purpose	Calibration Gas Analyte	Delivery	Frequency	Acceptance Criteria	Result
M320: Zero	Verify that the FTIR is free of contaminants & zero the FTIR	Nitrogen (zero)	Direct to FTIR	pre/post test	< MDL or Noise	Pass
M320: Calibration Transfer Standard (CTS) Direct	Verify FTIR stability, confirm optical path length	Methane	Direct to FTIR	pre-test	+/- 5% cert. value	Pass
M320: Analyte Direct	Verify FTIR calibration	Formaldehyde, N_2O	Direct to FTIR	pre-test	Determine FTIR response to be used for analyte spike calcs	Pass
M320: CTS Response	Verify system stability, recovery, RT	Methane	Sampling System	pre/posttest	+/- 5% of Direct Measurement	Pass
M320: Zero Response	Verify system is free of contaminants, system bias	Nitrogen (zero)	Sampling System	pre/posttest	Bias correct data	Pass
M320: Analyte Spike	Verify system ability to deliver and quantify analyte of interest in the presence of other effluent gases	Formaldehyde, N_2O	Dynamic Addition to Sampling System, 1:10 effluent	pre-test	+/- 30% theoretical recovery	Pass

VOC AND TOXICS COMPLIANCE TEST PROTOCOL

State Form 55058 (7-12)
Indiana Department of Environmental Management
Office of Air Quality, Compliance Data Section

RESET FORM

INSTRUCTIONS: Please complete this form and mail it back to: 100 N Senate Avenue, Mail Code 61-53, IGCN 1003, Indianapolis, IN 46204-2251; or fax it to: (317) 233-6865; or e-mail it to: Test_Protocol@idem.IN.gov.

Date Prepared:	05/18/2022	**Proposed Test Date:**	08/18/2022	**Plant Address:**	2255 West U.S. 20
Plant Location:	Lagrange, IN				

1. SOURCE INFO: ID/Permit No.: 087-42922-0004

Company:	ANR Pipeline Company
Mail Address:	700 Louisiana St. Suite 700
City, State, ZIP:	Houston TX 77002
Company Contact:	Pedro Amieva
Telephone:	(832) 320-5839

2. TEST COMPANY INFORMATION

Name:	Environmental Quality Manangement, Inc.
Address:	1280 Arrowhead Ct,, Suite 2
City, State, ZIP:	Crown Point A 46307
Contact:	Karl Mast
Telephone:	(219) 776-6056

3. PROCESS INFORMATION *(Submit a separate form for each unit to test.)*

Unit to Test:	TR01
Maximum Rated Capacity:	13,200 HP (9.86 MW)
Proposed Operating Speed:	=/> 90%
Describe method used to determine operating level:	Measure horsepower and or Megawatts Inlet temperatures 4 hour rolling average
Pollution Control Equipment:	SoLoNOx (lean/premix)
Process Description:	One natural gas fired Mars 90 stationary gas turbine, with ISO rating of 13, 220 hp (9.86 MW), using SoLoNOx (lean/premix) as control, exhausts to Stack S03
List and describe organic raw materials used in process:	
Person responsible for recording Process and Control Equipment data:	
Fuel Type:	Natural Gas

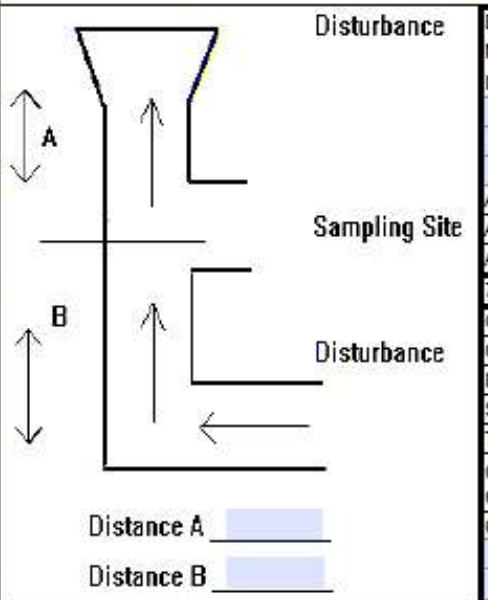
4a. TEST INFORMATION	No. Runs	Time
Method 1-4		
Method 18		
Method 23		
Method 24		
Method 25		
Other: 3A, 320,	3	60.0 min

5. Check Applicable Program:

Title V:	✓	FESOP:	
SSOA:		MSOP:	
Other:			

AGENCY USE ONLY:	**Date Received:**
Inspector:	**Approval date:**
Reviewer:	**Comments:**

6. SAMPLE SITE LOCATION



Does sample port location meet 40 CFR 60, Appx. A, Method 1, Sec. 1.2 Requirements:	Yes / No
If No, explain:	
Approximate Stack gas flow (ACFM):	
Approximate Stack gas temp (deg. F):	
Approximate Stack gas moisture (%):	

7. REASON FOR TEST:

Operating Permit: 087-42922-0004	Yes / No
Construction Permit:	Yes / No
If yes, Unit Start Up Date:	
State Agreed Order: Please include No.	
Title V:	Yes / No
Compliance with 326 IAC NSPS 40 CFR 60 Subpart A	Yes / No
Other (EPA, CD, State, 114):	40 CFR 63 YYYY

4b. Capture Efficiency Testing

Test Information	No. Runs	Time
Permanent Enclosure Method:		
Temporary Enclosure Method:		
Data Quality Objective Method:		

326 IAC 3-6-2(a) requires this completed form to be submitted 35 days prior to the proposed test date to the above address. 326 IAC 2-1.1-7(6)(B) requires any applicable test fee to be submitted with the protocol. ***(FEE NOT APPLICABLE IF PROGRAM IS FESOP, TITLE V OR VE TESTING ONLY.)***

1280 Arrowhead Ct., Suite 2, Crown Point, IN 46307 (219) 661-9900